

ALPHA CEMENT

Concrete Improvements
Around the Home

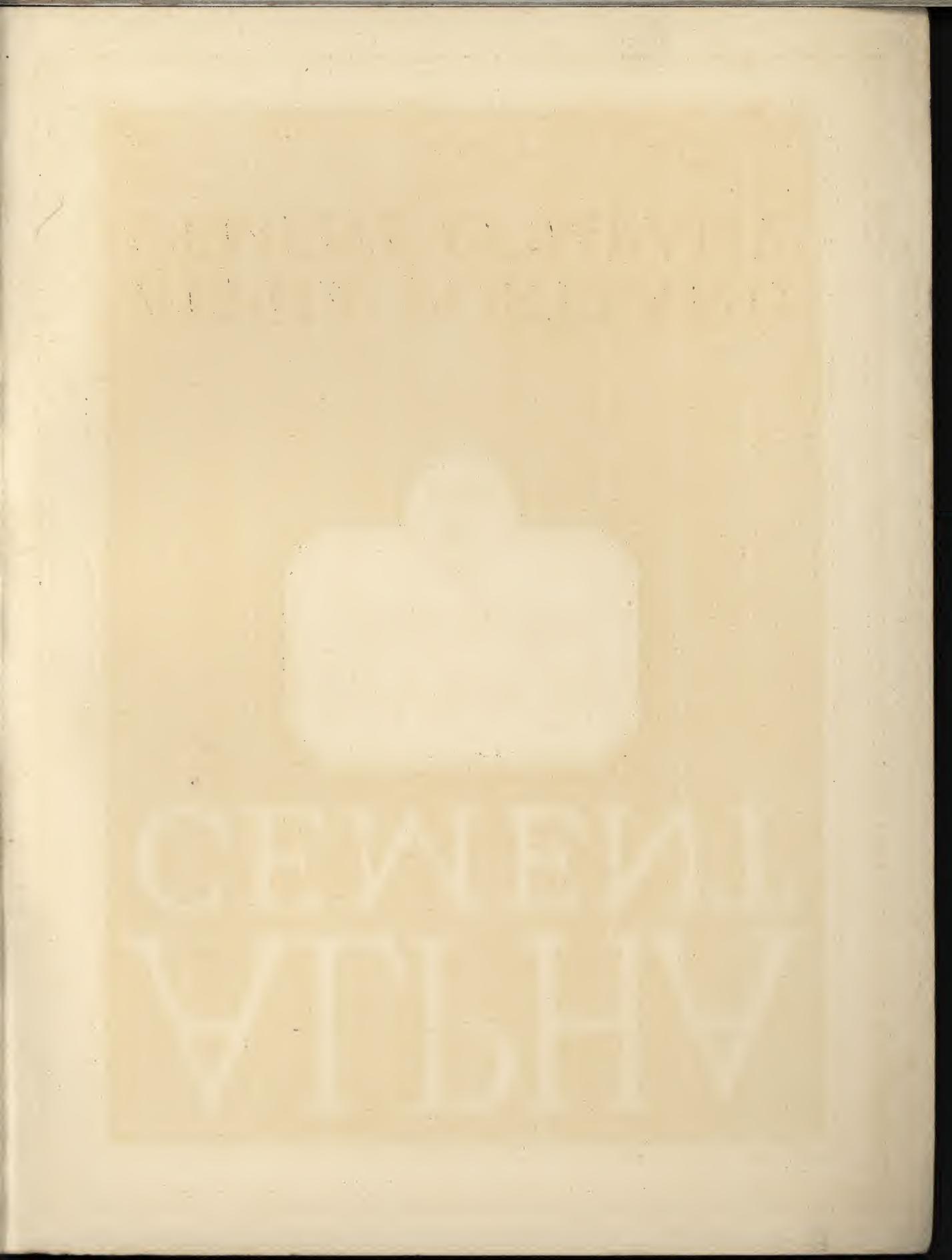


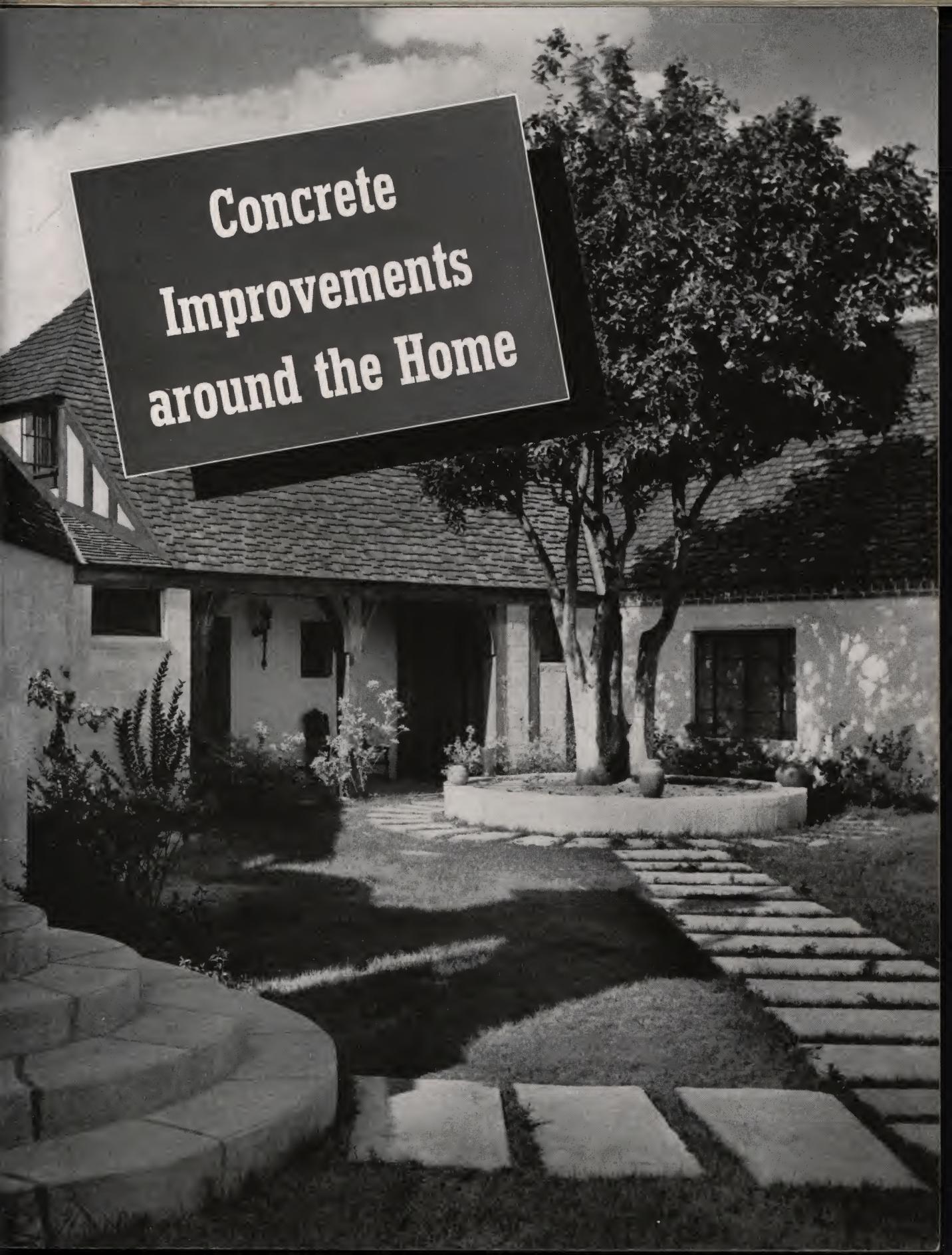
ALPHA PORTLAND CEMENT COMPANY

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Concrete
Improvements
around the Home

The activities of the Portland Cement Association, a national organization, are limited to scientific research, the development of new or improved products and methods, technical service, promotion and educational effort (including safety work), and are primarily designed to improve and extend the uses of portland cement and concrete.

The manifold program of the Association and its varied services to cement users are made possible by the financial support of over 60 member companies in the United States and Canada, engaged in the manufacture and sale of a very large proportion of all portland cement used in these two countries. A current list of member companies will be furnished on request.

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The drawings in this publication are typical designs and should not be used as working drawings. They are intended to be helpful in the preparation of complete plans which should be adapted to local conditions and should conform with legal requirements. Working drawings should be prepared and approved by a qualified engineer or architect.

Concrete Improvements Around the Home

IN town or country, concrete finds a wide range of usefulness for making improvements around the home that enhance the beauty and increase the utility and value of the property. It matters not how modest the home or limited the space in lawn or garden, concrete finds practical application. Furthermore, utilitarian and decorative improvements made with concrete are decidedly economical in first cost, durable, rot-proof, firesafe and practically maintenance-free.



Durable Sidewalks

CONCRETE walks meet all the requirements of a good footway. They are durable, smooth without being slippery, easy to clean and are pleasing to the eye.

The width to make the walk will vary with its use. Main pathways from the street to the house entrance should be rather wide; 4 to 5 ft. is a good width. Walks on the side or rear of the house are usually made from 1½ to 3 ft. wide.

The first step in construction is to prepare the base. If the soil is well drained, the concrete can be placed directly on it, after it has been well compacted. If the soil is not well drained a 6-in. subbase of well compacted, clean, coarse gravel, or clean cinders should be provided.

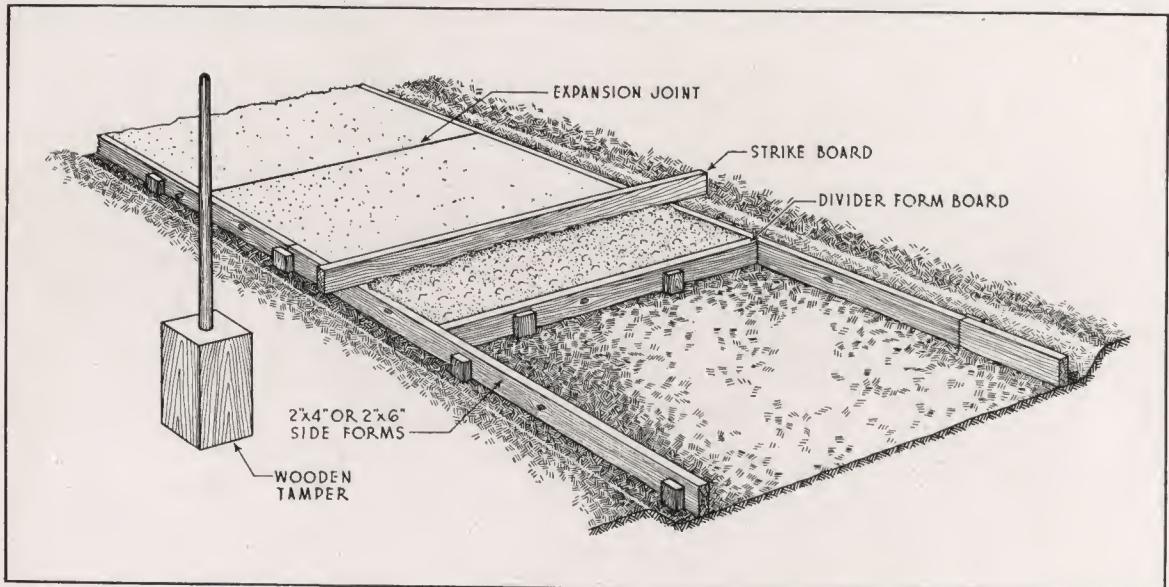
Thickness of walks varies from 4 to 6 in. If used only as a walk, 4 in. is usually thick enough, but if heavy vehicles are likely to be driven over the concrete the thickness should be 6 in.

Usually 2x4's are used for side forms, these

being held in place by stakes. The top edges of the 2x4's serve as guides in leveling off the concrete. It is good practice to build walks about 2 in. above grade so that they will be well drained. In building a 4-in. walk, therefore, the area that is to be concreted will have to be excavated to a depth of 2 in. plus the thickness of the fill. The walk should be sloped toward one side for drainage; a pitch of from $\frac{1}{4}$ to $\frac{1}{2}$ in. is satisfactory.

Walks are best built in 1-course construction which means that the full thickness of the concrete is placed at one time, using the same mixture throughout. To provide for expansion and contraction joints, walks should be divided at 4 to 6-ft. intervals, with partition strips placed at right angles to the side forms. Every other section is then concreted. After these have hardened enough to be self-sustaining the cross strips are removed and the remaining slabs placed.

Another method which has some advantages in



Forms and method of building 1-course sidewalk.



Concrete curb walks preserve the grass—prevent muddy shoes in rainy weather.

that it permits the walk to be built continuously, is to place strips of tarred felt against the division or header boards. When the header boards are removed these strips, which extend entirely across the walk and for its full depth, remain permanently in position providing a definite joint between sections. Concrete is placed on both sides of the header board before it is lifted out. Then the pressure of concrete from both sides holds the tarred felt vertically, as it should be.

The proper mixture of concrete to use for sidewalks will be found in the table on page 35. Also read the instructions for proportioning, placing and curing on pages 35 to 38. The concrete mixture, when of the right plasticity, is easily leveled off by a strikeboard resting on the edges of the side forms. This strikeboard is passed across the forms in a saw-like motion, thus leveling the concrete. Several hours after concrete is placed the walk is finished with a wood float to produce an even, gritty surface. To assist in curing, a covering of moist sand or earth, about 2 in. thick, is put on the concrete as soon as it has become sufficiently hard to resist marring, and is kept



Flagstone or stepping-stone walks of concrete add greatly to the charm of the home.

moist for about 7 days. The covering may then be removed and the walk put into use.

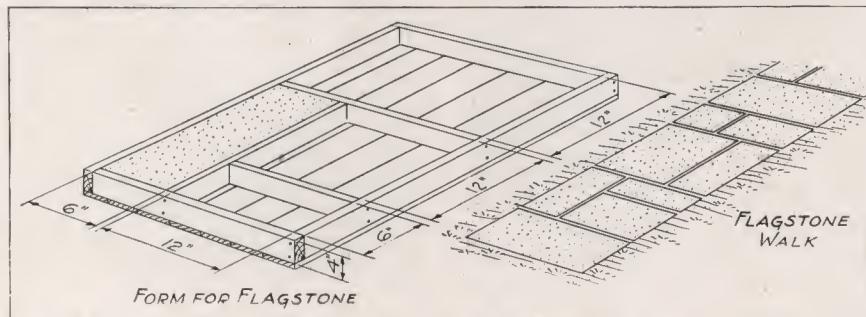
Flagstone Walks

In the garden it is often desirable to construct a flagstone type or a stepping-stone type of walk.

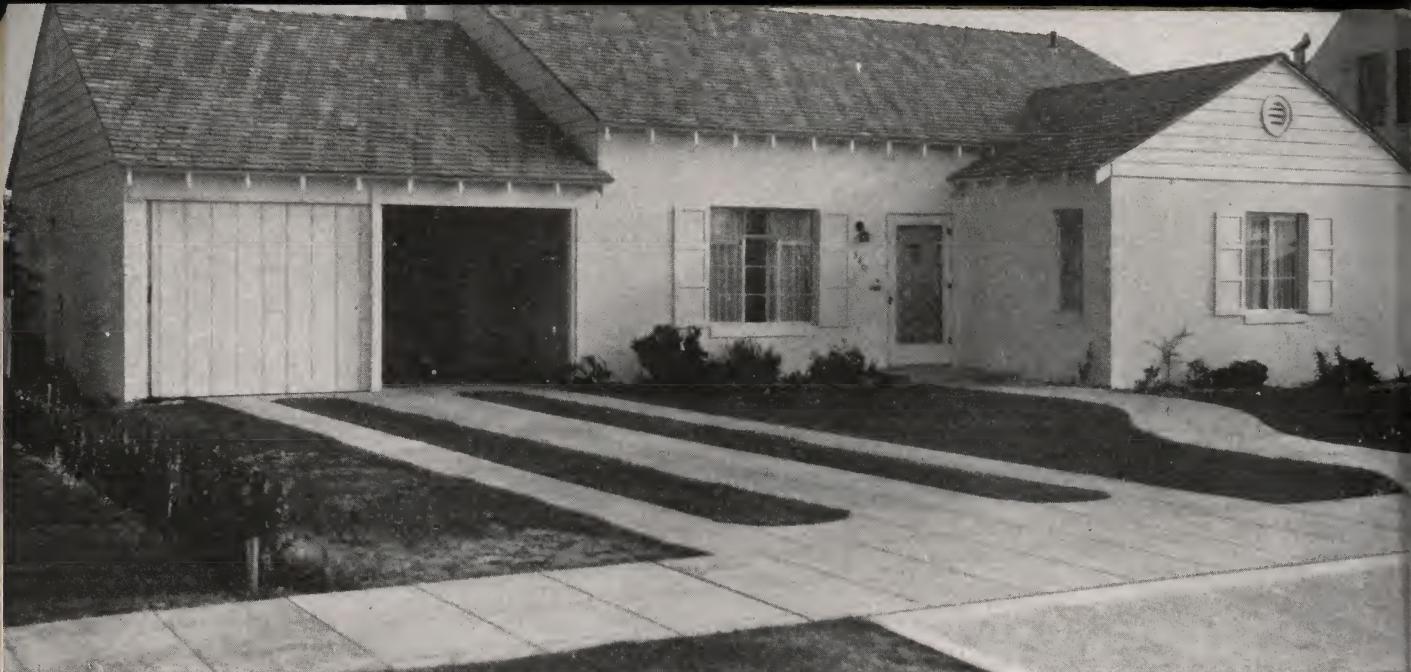
Simple forms for making flagstones of concrete are shown on this page. The various sizes of stone may be placed in any one of a number of interesting designs, one of which is shown. Since the forms will be used several times, they should be assembled so that they may be taken apart easily. Oil them well before concreting. The same mixture of concrete and method of placing and curing as described for the ordinary sidewalk may be used.

In making stepping stones irregular holes may be dug in the ground in the position in which the stones are to lie. The concrete is then placed into these forms and smoothed off and allowed to cure as recommended.

Mineral color pigments are often introduced into the mixture to produce stepping stones or flagstones of different shades.



Method of constructing forms for flagstone walk.



Where a drive is used only occasionally, parallel strips of concrete provide satisfactory approach.

Year Round Driveways

An attractive concrete driveway adds much to the appearance of the grounds, and provides a year round passage to the street or highway.

The type of driveway to build is largely dependent upon how it is to be used. Where sub-

jected to hard service, pavements covering the entire drive area give best satisfaction. Parallel strips of concrete often are satisfactory where the drive is subjected only to occasional use. However, this type of driveway should be built



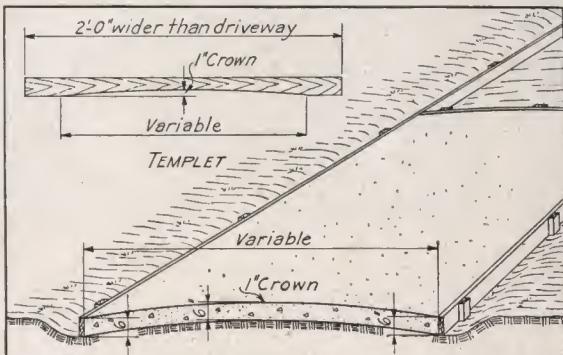
A concrete driveway provides year round passage to the street or highway.



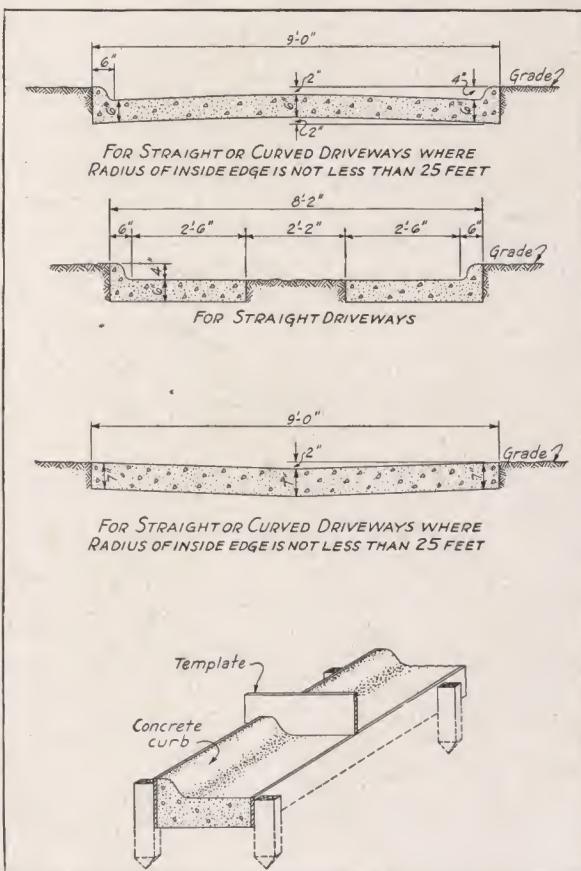
A patterned colored concrete drive. The colored topping is laid on a strong concrete base.

with curbs on the outer edges to protect the lawn.

The pavement type of driveway is usually made from 8 to 10 ft. wide. A 6-in. slab is recommended in order to take care of coal and other



Method of constructing pavement type of driveway with crown.



Designs for several types of concrete driveways.



A concrete driveway enhances the value of the property, affords dependable access to the house.

delivery trucks. The center of the driveway should be given a crown or valley to insure drainage. The crown or valley is produced by means of a templet which shapes the surface so that the center is higher or lower than the outer edges as shown in the drawings. The base also is shaped so that the finished pavement will have a uniform thickness. The area upon which the pavement is to lay should be well compacted before concreting.

Use 2x6's or 2x8's for side forms and set cross-pieces at right angles every 20 or 30 ft. to provide expansion and contraction joints. The alternate section method of construction may be used or the driveway may be built continuously as described in sidewalk construction on page 5. One-course construction is recommended using the same mixture of concrete throughout. Methods of placing and curing are as for sidewalk construction. See pages 4 and 5.

Finishing is done with a wood float a few hours after placing concrete, when it is stiff but still workable. An old canvas or rubber belt, 4 to 6 in. wide and 12 ft. long will be found very useful in producing an even surface for flat or crowned pavement. The belt is drawn back and forth across the pavement, working slowly forward as the concrete is brought to desired smoothness.



Concrete steps are safe, nonslippery in wet weather and easy to keep clean. The concrete steps with sidewalls (left) have been given an attractive granite finish.

Permanent Steps and Porch Floors

How often we see an otherwise attractive home with the porch and the outside flight of steps sagging, badly worn, or decayed. Such steps and floors are a constant source of danger as well as bother and expense.

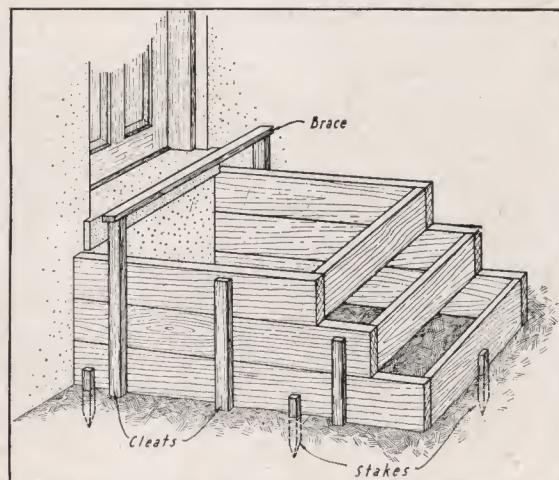
Concrete porches and steps are attractive, safe, nonslippery in wet weather and last indefinitely. They are easy to keep clean, and will not rot or burn.

Concrete Steps

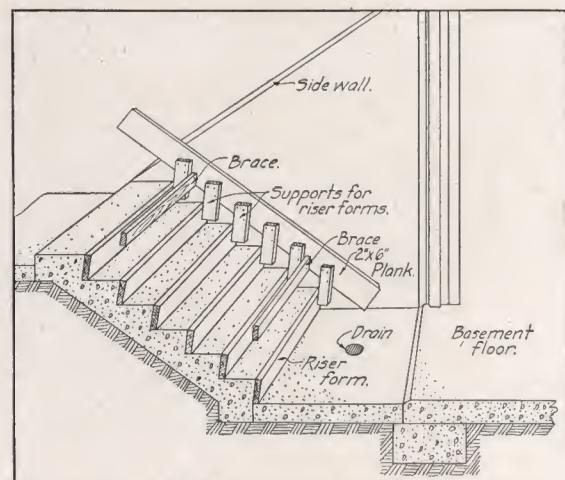
For a comfortable flight of steps the rise from

one step to the next should not exceed $7\frac{1}{2}$ in.; the width of tread should be about 10 in. Either 1-in. or 2-in. lumber may be used for forms. The mixture for this type of construction is given in the table on page 35. The concrete should be of rather stiff consistency. Finishing with a wood float produces a smooth yet gritty surface.

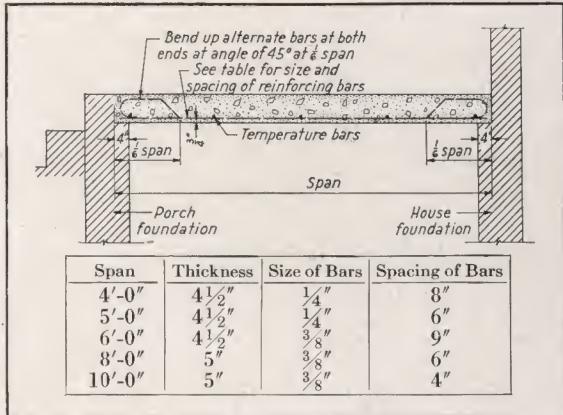
When steps are built with sidewalls, the latter are placed first and allowed to harden. The steps are then placed and if resting on well compacted ground will need no reinforcement. Forms consist of planks held firmly in place by means of



Simple forms for building concrete steps.



Forms for basement steps.



Cross section of reinforced concrete porch floor.

1x4-in. braces against the sidewalls. To the planks are nailed 1x4's for holding the riser forms in place. These supports come within 2 in. of the treads. Crosspieces, usually of 1-in. material, and 8 in. wide are nailed to these to make riser forms.

Concrete Porch Floors

In building porch floors or terraces of concrete the same principles of construction apply as for sidewalk construction. If the ground upon which the porch floor or terrace is to rest is well drained the concrete may be placed directly on it; if not,



Concrete porches are lasting improvements. They are rotproof and termite-proof.

a subbase from 4 to 6 in. thick of clean, coarse gravel or cinders should be provided. A well compacted subbase is essential. Where the porch floor rests on a firm fill, it will need no reinforcement, but if over an excavation or part of the basement it will need reinforcement in both directions as shown in the drawing on this page. The recommended concrete for porch floors is given in the table on page 35. Finish with a wood float to secure a smooth, yet gritty surface and cure as recommended. Porch floors are given a slope of $\frac{1}{4}$ in. to the foot, to insure drainage.

Foundation and Basement Walls

FOUNDATION walls of cast-in-place concrete or concrete masonry not only give needed stability to new and old structures, they are also fundamental to dry, watertight basements. Whether a new home is being built or an old structure is being modernized, the owner should consider the advantages of the service, storage and recreational facilities provided by the well-planned basement.

Proper construction methods and materials for footings, cast-in-place concrete and concrete masonry foundations, and basements are fully described in the booklet, *Foundation Walls and Basements of Concrete*, which is available on request to the Portland Cement Association.



This home is being given a durable, termite-proof concrete masonry foundation.



An ornamental garden wall adds to the beauty of the grounds and gives a sense of privacy.

Garden Walls and Retaining Walls

ORNAMENTAL walls enclosing the garden or the entire property add to the beauty of the grounds as well as give a sense of privacy. Retaining walls to hold embankments or terraces in place are also useful improvements. Concrete is the ideal construction material because of its durability, economy and the variety of surface treatments that it permits.

Walls may be cast in place or built of concrete masonry. In either case the wall should be carried down to solid footing and in severe climates below the frost line.

If the wall is to hold an embankment in place, special construction is necessary to give it added weight and stability. Where embankments are not more than 3 ft. high this may be accom-

plished by filling the cores of a concrete masonry wall with a rich concrete mixture in which reinforcing rods are inserted. Where embankments exceed 3 ft. in height some provision should be made for bracing the wall with pilasters at regular intervals or for securing suitable anchorage in the earth embankment.

A 1:3 mortar (1 sack of portland cement to 3 cu.ft. of sand), to which a plasticizing agent may be added, is recommended for laying up a concrete masonry wall. The mortar should be mixed thoroughly with just enough water to give plasticity and workability, as described on page 36. Care should be taken to see that each unit is well embedded in mortar and that the joints are filled and pointed.

A surfacing of portland cement stucco may be applied to the wall if desired. Textures and colors may be chosen to harmonize with the home and surroundings. A garden wall with stucco of a well selected texture and color forms a perfect background for flowers and shrubbery.

Another popular type of masonry wall treatment is to apply a brush coat of portland cement wash to the wall so that the masonry character is retained and joint markings remain visible. When color is desired mineral pigments which are usually obtainable from local building material dealers may be incorporated in the wash coat.

Masonry units are sometimes laid up in a random fashion with varying numbers of units protruding slightly from the face of the wall, thus effecting an appearance of ruggedness. The use of more mortar than is actually necessary, commonly called protruding mortar joints, is also employed to create a rough-textured finish.

Forms for cast-in-place walls should be rigid and well braced in order to withstand the pressure of the wet concrete and produce a straight, even wall without bulges. For keeping form faces the proper distance apart, inner and outer sections should be clamped or wired together against wood spacers or spreaders. The spreaders are removed as the forms are filled with concrete. If the earth is firm the sides of the excavation will serve as forms for the wall below grade; if not, forms must be carried to the bottom of the excavation.

Where the retaining wall must support a considerable load, a gravity wall will be found satisfactory. It is called a gravity wall because its weight is sufficient to keep it from leaning or

Extruded mortar joints give a rustic effect to this concrete masonry garden wall.

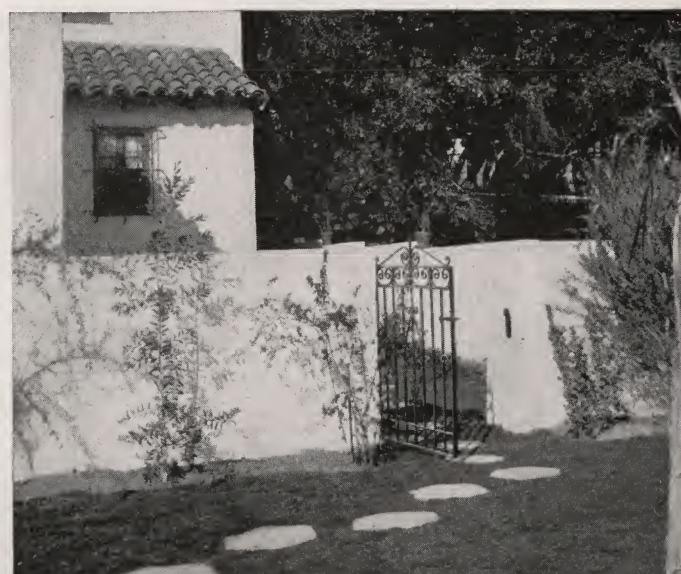


Concrete retaining walls give the property a trim, neat appearance as well as protect the land from costly and unsightly soil erosion.

turning over as a result of earth pressure on one side. A wall of this type requires no steel reinforcement. The width of the base is made equal to one-half its height. The top of the wall should be at least 6 in. thick regardless of its height.

The recommended mixture for cast-in-place walls is given in the table, page 35. Also read the directions for proportioning, mixing and placing. The concrete should be placed in the forms in layers of from 6 to 10 in. deep and in a continuous operation if possible to avoid construction seams. The concrete should be well spaded next to form faces so as to obtain smooth, even surfaces.

A pleasing concrete masonry wall painted white. Note concrete stepping-stone path.





This lily pool adds much to the charm of its formal garden setting.

Concrete Lawn and Garden Pools

CONCRETE is ideally suited for pool construction because being easy to mold it lends itself to a wide diversity of designs.

A wide variety of aquatic plants suited to the garden pool may be obtained and the selection of the size of the pool is somewhat dependent upon the type of plants to be grown. Small species of water lilies for instance will require a pool only 3 ft. in diameter while larger varieties require a pool at least 6 ft. in its least dimension.

The depth is dependent upon the type of planting (water lilies require at least 22 in.) and the climatic conditions. In severe climates shallow pools are likely to freeze solid in the winter and kill the plants unless precautions are taken. The usual method of preventing an excessive thickness of ice from forming is to board the pool over and cover with straw or leaves. Goldfish should always be removed from the pool in winter but hardy lilies will not be harmed if the ice does not freeze to a depth of more than 2 or 3 in.

A simple and attractive design for a small pool is shown on next page. The curved ends shown

may be eliminated and the plans altered to suit individual requirements.

Excavation to the desired form and depth is the first step in construction. If the soil is firm no outside form will be needed. When the soil is loose and crumbly both inner and outer forms will be required. The pool should rest on well compacted ground. Forms for the curved ends of the pool are made of 20-gage galvanized iron. Since the pool must resist exterior soil pressure and in the winter, interior ice pressure, reinforcement must be used and placed as shown. It is necessary that concrete for the floor and walls be placed in one operation so that there will be no construction joints and therefore less possibility of leakage. Support the interior form across the top of the excavation so that it hangs 6 in. from the bottom of the pit. Be sure to oil the inside faces of the forms well before concreting to facilitate their removal. Deposit only 6 to 8 in. of concrete at a time in the wall forms and see that it is well tamped and spaded. A garden hoe with the blade straightened out makes a good tool for spading. The reinforcement is put

in position before the concrete is placed. Take care that it is not displaced by tamping. Forms are not removed for at least 48 hours after concreting.

The concrete must be watertight. Use the recommended mixture shown in the table on page 35 for the walls and floor. If lilies are to be grown in the pool and tubs are not desirable, several circular pits 10 to 12 in. in diameter may be provided in the floor of the pool. The walls and floor of the lily pit should be the same thickness as the pool floor.

Often pools are built entirely above grade and where this is done it is recommended that the pool be built on a well tamped fill of gravel. The forms and general construction of this type of pool will be practically the same as the below-grade type, except that both inner and outer forms will be required.

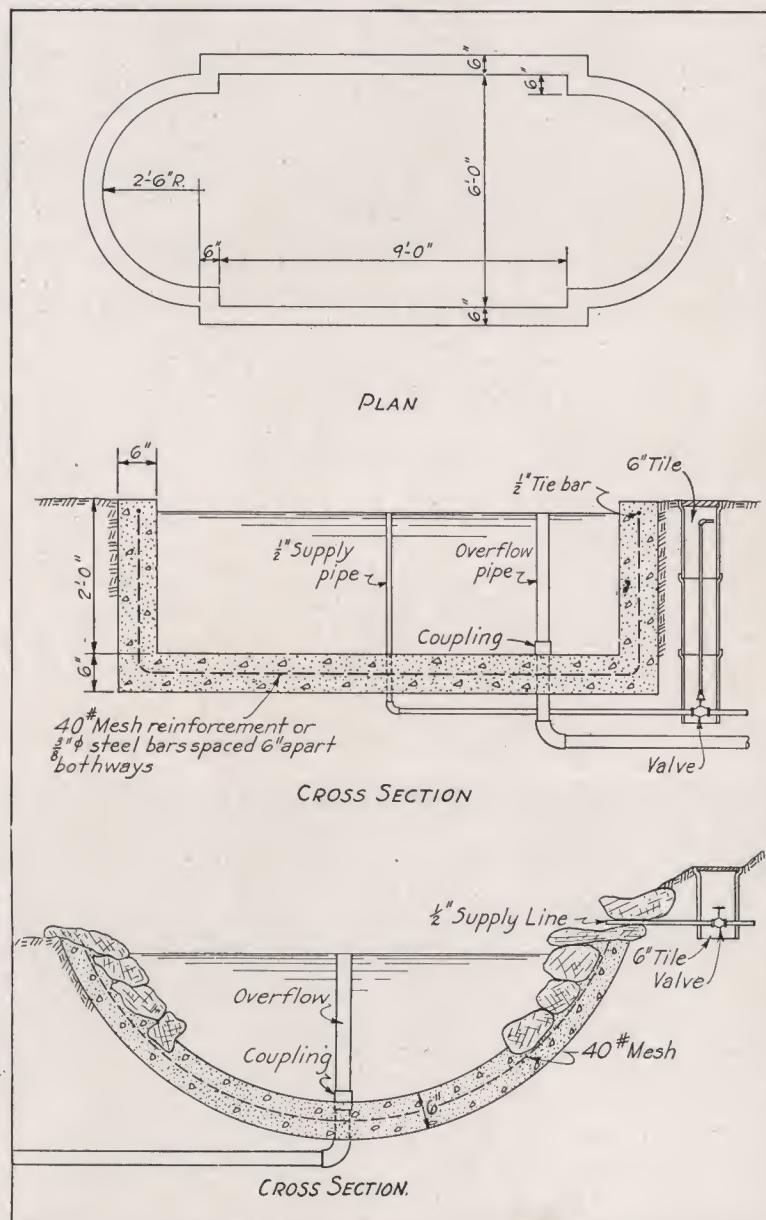
A realistic rock pool may be constructed by making an irregular excavation with a bowl-shaped bottom. If the concrete is made in accordance with the recommended mixture given on page 35 and the sides are not steeper than a rise of 1 ft. in 2 ft., no forms will be needed. Natural rock may be set in the concrete before it has hardened.

While the pool may be filled with a garden hose, pipe connections with the local water supply are desirable. The pool may be emptied by siphoning or by a drain in the bottom. In the latter case the overflow serves also as a drain by unscrewing the length of pipe above the coupling set flush with the floor. When this method is used a wire basket is placed over the outlet in case fish are kept in the pool. All plumbing connections should

be placed before concreting begins.

When water is first placed in newly constructed concrete fish pools it is likely to be strongly alkaline and may result in the fish being killed.

It is a simple matter to determine when the pond is safe for fish. Pink litmus paper is placed in the water. If it turns blue, the water is alkaline and is not safe for fish. Water in the pool should



Plans and construction details for two types of garden pools.



A delightful, informal garden pool. The garden wall is concrete masonry stuccoed.

be changed at weekly intervals until pink litmus paper remains pink when placed in the water.

Some owners have gone over the surface of their pools with several coats of sodium silicate (paint consistency) immediately after the forms have been removed. This has a tendency to eliminate the alkaline condition by sealing the concrete surfaces, with the result that fish can be placed in the pool at an earlier time.

The pink litmus paper test is recommended in

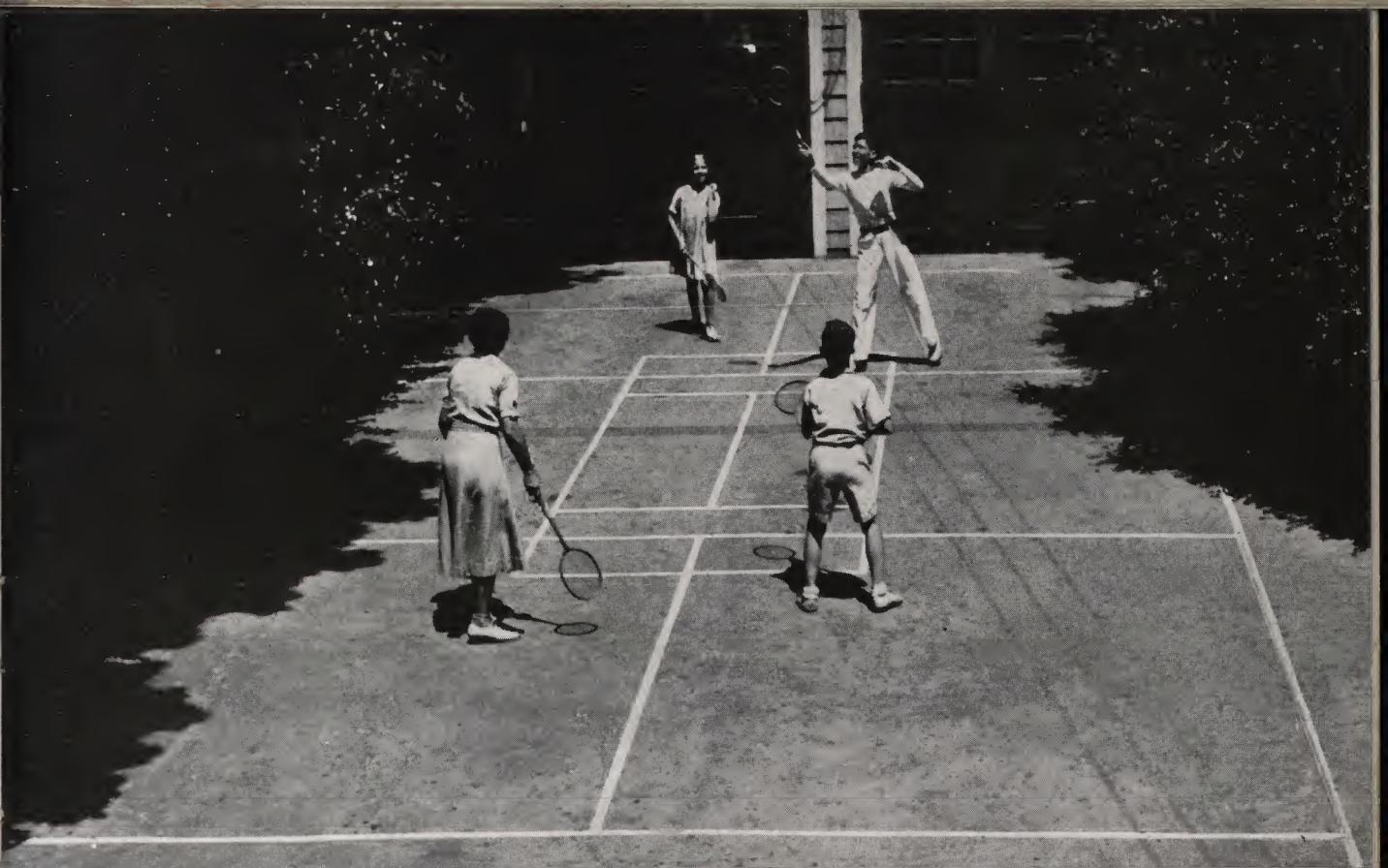
any event to make certain that you are not taking any chances of losing the fish.

Bog gardens are often desirable for the growing of semiaquatic plants. Japanese iris is a popular plant for this type of garden. To construct such a garden, excavate to a depth of 16 to 24 in. and build a reinforced concrete box 4 in. thick. Fill the box with a rich soil such as old turf mixed with well rotted cow manure.

Note: Pink litmus paper and sodium silicate (water glass) can be obtained at your local drug store.

The rustic flagstones and rock garden background enhance the beauty of this attractive pool.





Widen your driveway a little and play badminton and paddle tennis in your own back yard.

Concrete Play Courts

You don't need an estate to have private play courts. Paddle tennis, badminton, basketball, shuffleboard, and many other games can be played on small courts in the back or side yard.

The accompanying picture shows how easily a multiple-use play court can be provided by building the garage driveway somewhat wider than usual and marking off game lines on the concrete.

The principal requirement of play courts is a true, even playing surface. Because concrete meets this requirement, it is widely used for play court construction. When properly placed concrete provides a permanently true, even, all-weather playing surface which requires little or no maintenance. In fact, the only maintenance needed is the occasional repainting of playing lines, and even this is easily eliminated by using colored concrete for the playing lines when the court is built.

The construction of a play court differs little from that of a well built sidewalk or driveway, except that more attention must be given to secure the proper finish. One-course construction is usually employed for ordinary courts, but for shuffleboard and when a special or colored surface is desired, a 2-course construction is recommended*.

Concrete mixture for play courts is given in the table on page 35. In finishing the wearing surface of the court, the concrete should be fairly

*Two-course construction, surface finishing and curing of a shuffleboard court are given in Concrete Information sheet, *Shuffleboard—A Deck Sport Comes Ashore*. Complete information on colored concrete construction is contained in two Concrete Information sheets, *Mineral Coloring Pigments for Use with Portland Cement* and *Colored Concrete Pavements and Walks*. Suggested specifications for reinforced concrete tennis courts are also available. These data sheets may be had on request to the Portland Cement Association.

stiff and require light tamping to settle it in place. It should be brought to grade with a straightedge, leveled with a wood float and again tested with a straightedge. Delay steel-troweling until the water sheen on the surface is disappearing and until the concrete is stiff enough so that an excessive amount of fine material will not be brought to the surface by the trowel. At this time the concrete will bear the weight of the finisher on knee boards. It should then be steel-troweled until the desired finish is obtained.

Machine-grinding gives a satisfactory, smooth playing surface for shuffleboard courts and bowling alleys. Such grinding should not be done, however, until the curing period is completed. If the surface is to be machine-ground, the final steel-troweling should be eliminated.

Where good footing is desired, such as on tennis courts and the ends of shuffleboard courts, the troweled concrete should be lightly brushed in one direction with a fine hair broom.

Curing is one of the most important operations in concrete play court construction. If the concrete is not cured, the mixing water needed for hardening evaporates too rapidly, possibly resulting in surface checking or cracks. Premature drying also causes the surface to dust under play. Curing should be started as soon as the concrete is hard enough to resist marring and, for ordinary court construction, should continue for a period of 7 days.

The method of curing will depend on the conditions at hand. Building earthen dikes and flood-



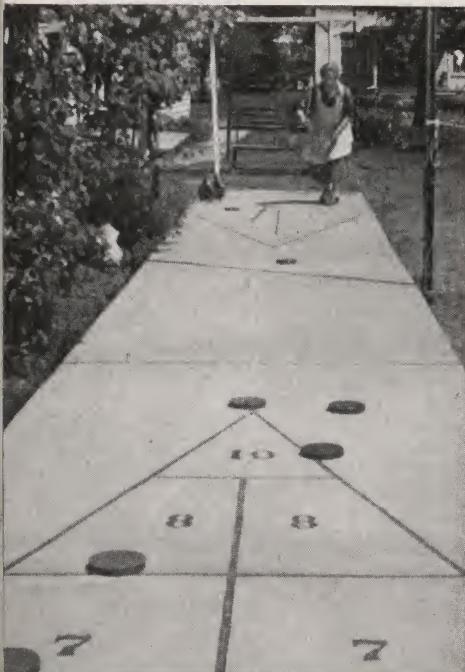
Table tennis is fun—outdoors it is played on concrete. Mother can use the table between times for luncheon parties.

ing the court with water is a highly efficient curing method. A 2-in. layer of clean sand, or a covering of burlap, kept wet for 7 days is also satisfactory.

Following completion of the curing period, the courts should be allowed 4 or 5 days to dry before playing lines are painted on.

A high quality paint made with an oil or varnish base is satisfactory for use in marking playing lines on concrete courts.

A shuffleboard court requires only a narrow strip in the garden.



You don't have to register, pay a fee or stand in line to play paddle tennis on your own court.



Concrete Lawn Benches

LAWN or garden benches are useful and add much to the appearance of the yard. Plans and construction details for a bench of simple design are shown below.

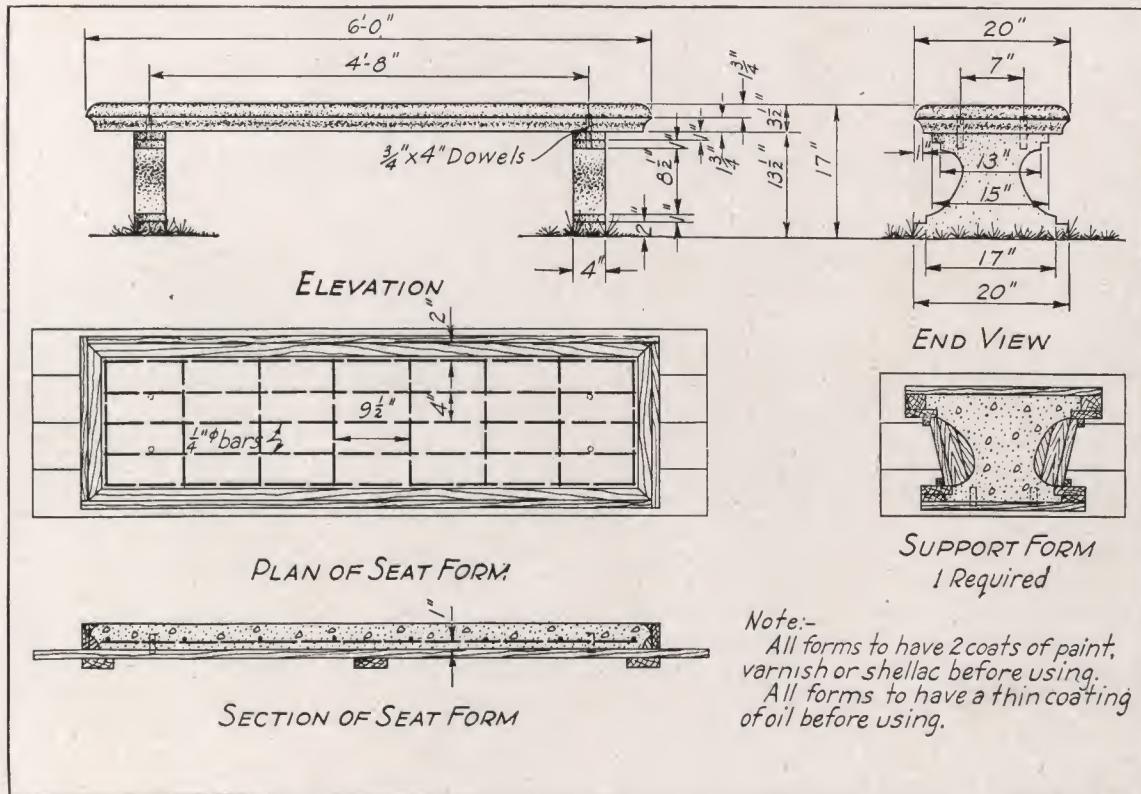
The seat mold is made of 1-in. boards planed so that the inner surfaces will be smooth and level. The inner sides of the forms are lined with molding as shown, so that the edges of the seat will have a finished appearance. Holes are bored in the bottom form boards in which plugs are tightly inserted to provide holes in the concrete for dowels which key the seat to the supports. Reinforcement consists of $\frac{1}{4}$ -in. steel bars placed as shown. Form for supports is also built of 1-in. boards with the exception of the curved portions which are made of galvanized sheet metal properly bent and braced. Dowel holes are also provided in the supports. To prevent warping of



A lawn bench with permanent concrete standards.

surfaces both forms should be painted with two coats of varnish or shellac. Before the concrete is placed they should be given a thin coat of light lubricating oil.

The proper mixture for this type of work is shown in the table on page 35. Place a layer of



Details of construction for a simple concrete bench.

concrete 1 in. deep over the entire bottom of the seat form. Reinforcing rods may now be placed in both directions as shown and the remaining 2½ in. of concrete tamped into the form. In no case should the reinforcement be nearer than 1 in. to the surface of the concrete. The surface can be leveled with a straightedge or planed board and then lightly troweled to produce a smooth surface.

Concrete for the supports is placed in much the same manner except that no reinforcement is required. A trowel should be run around the mold edges and up and down in the concrete. This operation removes air bubbles and produces a dense concrete with smooth surface.

After the forms have been filled they should remain undisturbed for at least 24 hours and during cold weather, for 48 hours. Great care should be exercised in removing the forms so as not to injure the green concrete. The supports and seats upon being removed should be covered with sand or straw, kept moist for at least 10 days. The bench should not be set up for at least 4 and preferably 6 weeks. Three-quarter-inch hard wood plugs may be used for dowels to attach the seat to supports.



A concrete bench is an attractive addition to the lawn or garden.

Where garden furniture is to be placed on the turf it is essential that a good solid footing be provided to prevent settlement when the ground becomes soft. Footings for benches should cover about double the area of the base of each standard—a depth of 6 in. is usually sufficient.

To prepare the footings dig holes of the required size and depth and fill with a mixture of concrete of the same mix as used for the bench. Tamp well, level off and allow to harden 24 hours before placing the bench upon them.

Concrete Bird Baths and Pedestals

A BIRD bath is an attractive feature for the lawn or garden and is worthy of much wider use.

Plans for a simple bird bath and pedestal are given on page 19. The forms for the pedestal are assembled as shown; shellac to prevent warping and oil their interior surfaces to facilitate removal. Use the concrete mixture recommended in the table on page 35. Reinforcement for the pedestal consists of four ¼-in. steel rods bent as shown and placed so that they will not be nearer than 1 in. to the surface. In placing the concrete, deposit a small amount in the forms compacting it by tamping with a stick or lath cut like a chisel at one end. Take pains in placing the concrete so that the reinforcement will not be moved. After the concrete is placed a round hard wood plug or dowel is centered in the fresh concrete to provide attachment for the separately-built basin.

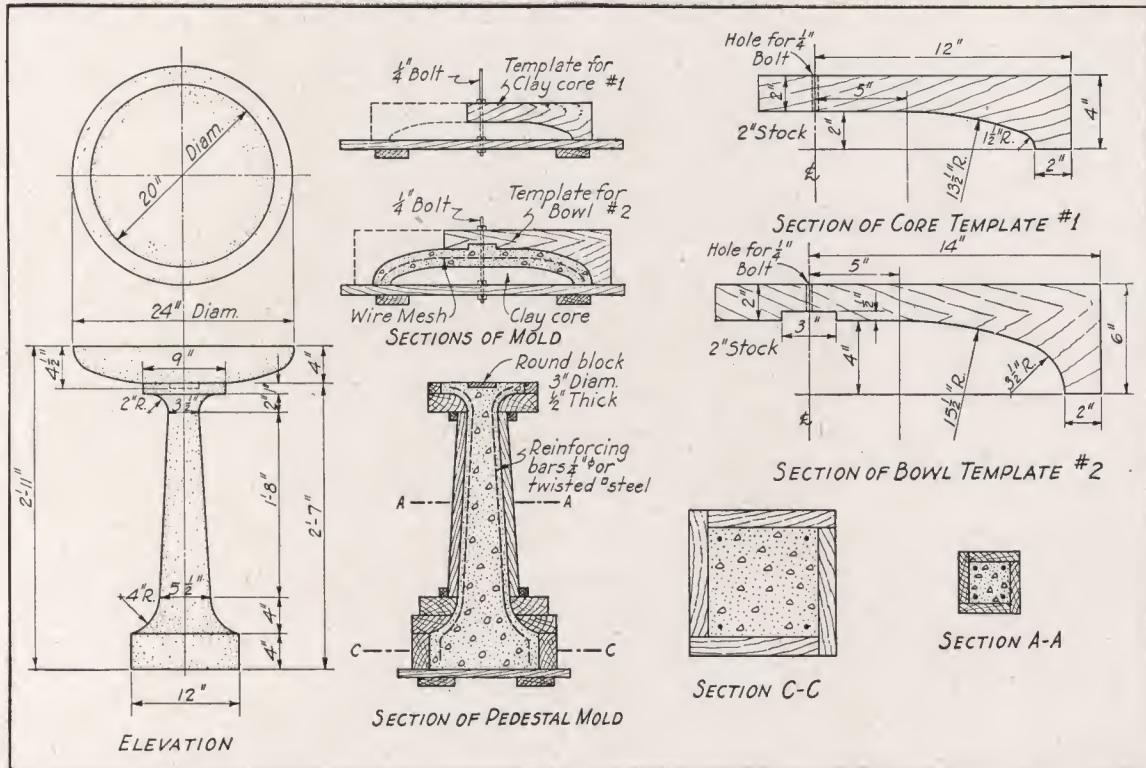
A smooth platform about 36 in. square is re-

quired in building the bowl. A ¼-in. bolt 8 in. long is fastened in an upright position in the exact center of the platform. This bolt is used as a pivot for the templets which shape the core and the bowl of the bird bath.

The templets may be made of wood as shown or cut from sheets of metal. The curvature may be varied to suit the design. The mold or core,



A concrete bird bath introduces variety into the lawn or garden and attracts feathered visitors.



Plans for concrete bird bath and pedestal. The pedestal design may be used for sun dials, gazing globes or other ornaments.

forming the basin, is built up of moist clay or a plastic clayey mixture. Templet No. 1 is placed on the bolt and revolved as the clay is built up to produce a smooth, even core. Templet No. 1 is then removed. After the clay has stiffened, which will require several hours, a 1-in. layer of concrete is placed over the clay and the reinforcing mesh is put in position. The second templet is then placed on the bolt or pivot and as more concrete is placed the templet is revolved and the

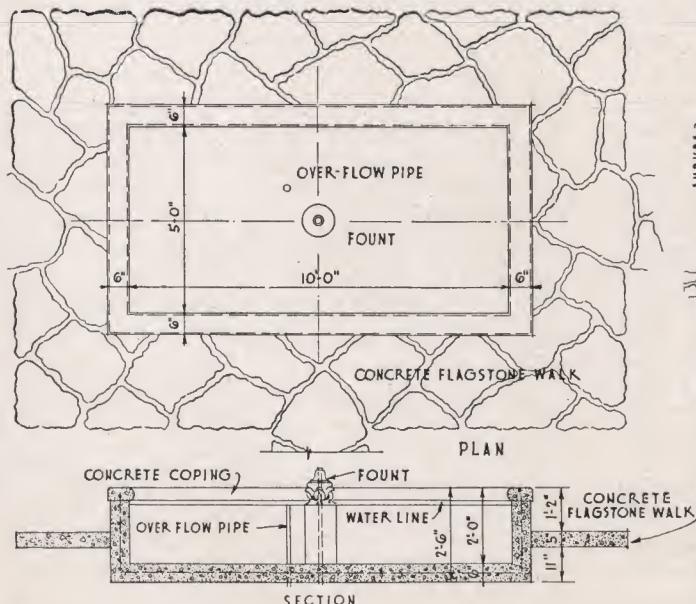
This gazing globe with pedestal of concrete adds a touch of contrast to the informal garden.

bottom of the basin formed. The concrete mixture in this case must be stiff so that it will not slide down. Less water or slightly more aggregate than will produce a customary workable mix will accomplish this. Use 4 gal. of water per sack of cement or relatively less if aggregates are moist. See table on page 35. The surface may be lightly troweled to obtain the desired smoothness.

Allow the pedestal and basin to harden for about 48 hours after which they may be assembled by means of the hard wood dowel. The entire bird bath may be given a portland cement wash.

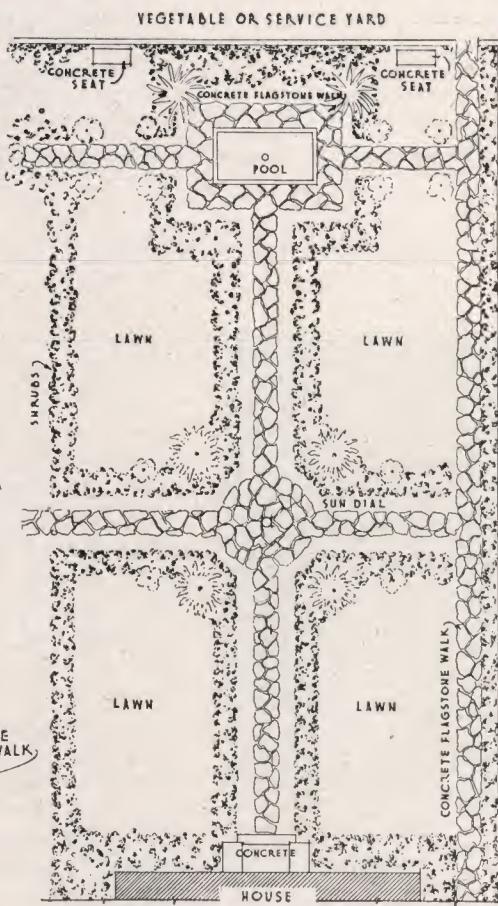
This pedestal design may be used for any of a number of garden ornaments including the sun dial, the gazing globe, urns, flower boxes, etc. In some cases such as for the sun dial the top of the pedestal will have to be made slightly larger than shown for the bird bath. Twelve inches square is about right for the average sun dial. If placed on the turf, always provide a concrete foundation for the pedestal slightly larger than the area of the base and about 8 in. thick.





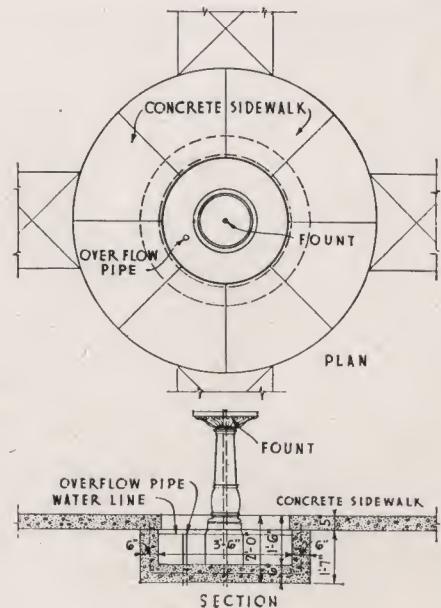
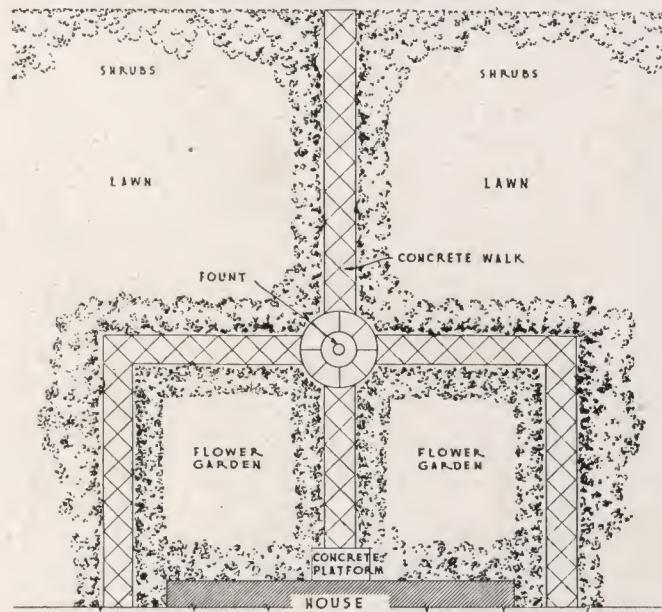
SUGGESTED LAYOUT OF SEMI-FORMAL GARDEN
CONCRETE FLAGSTONE WALK-POOL-SEATS - ETC.

Concrete for Gardens





VEGETABLE GARDEN OR SERVICE YARD



SUGGESTED LAYOUT OF REAR OR SIDE YARD WITH FLOWER GARDEN
CONCRETE POOL AND SIDEWALK IN SIMPLE PATTERN

Flower Pots and Boxes



A flower pot and pedestal of concrete.

sembling take care to have both inside and outside forms exactly centered. Oil the form faces well before placing concrete.

The recommended concrete mixture for this class of work is shown in the table on page 35. As the forms are filled, press the concrete into the corners. Allow the concrete to harden for at least 24 hours before removing forms. Any irregu-

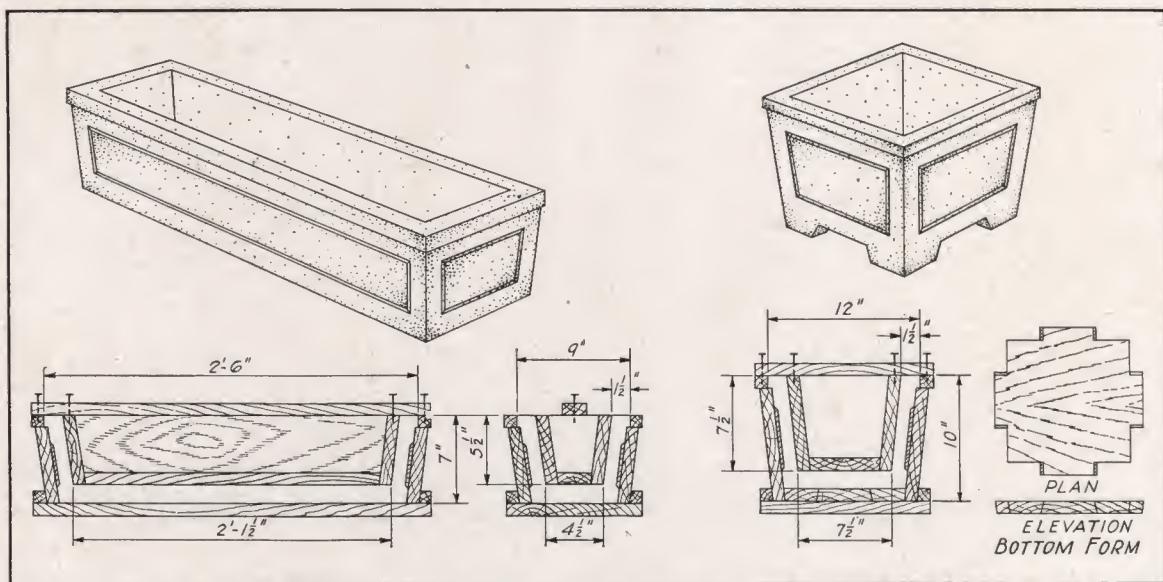
SIMPLICITY is always in good taste. Attractive concrete flower pots and window boxes, of similar design to those given here, are inexpensive to build.

The surfaces of forms next to the concrete should be s a n d p a p e r e d smooth and at least two coats of shellac applied to prevent warping. When as-

larities or bubble holes are filled at this time with a wash of portland cement and water mixed to the consistency of thick cream. The entire inner and outer surfaces may then be coated with this mixture. Cure for at least a week wetting thoroughly every day.



Flower boxes can also be built with pedestals.



Left—Plans for concrete flower box. Right—Plans for concrete flower pot.

Sun Dials

THE sun dial is a garden ornament of many years' standing and one in which designs range from simple to elaborately ornate. Whether used for lawn or garden, a concrete sun dial makes for interesting contrast with surrounding greenery. The sun dial may be treated as the central feature of the garden and given a prominent position, or as an isolated feature it may adorn some secluded nook.

An attractive sun dial of simple design can be readily made by following the plans given for the pedestal described on page 18. However, the top of the pedestal will have to be made slightly larger than shown for the bird bath. The dial itself is often made of brass or bronze and may usually be secured from stores dealing in lawn and garden equipment. While the weight of the dial is usually sufficient to hold it firmly on the pedestal it is good practice to cement it in place or put it into a depression cast in the top of the



Sun dials are a never-ending source of interest and serve as an attractive focal point in the garden.

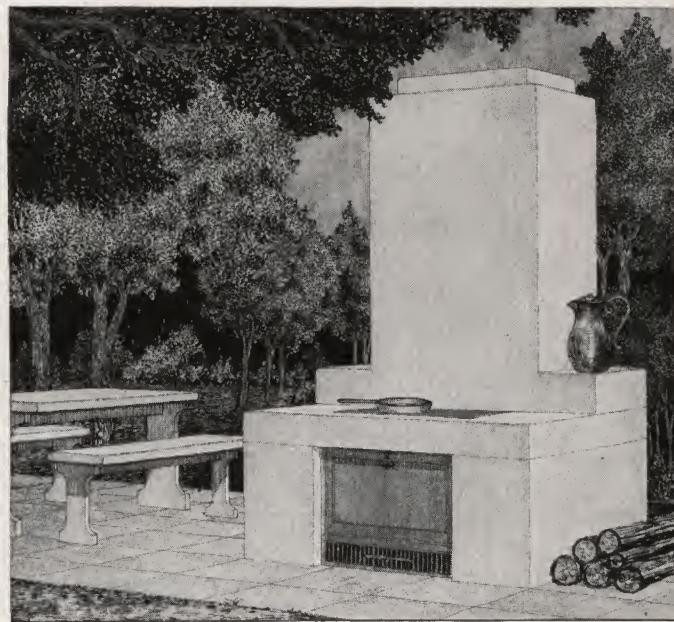
pedestal to receive it. When placing the sun dial always see that its vane points to the north.

Outdoor Fireplaces

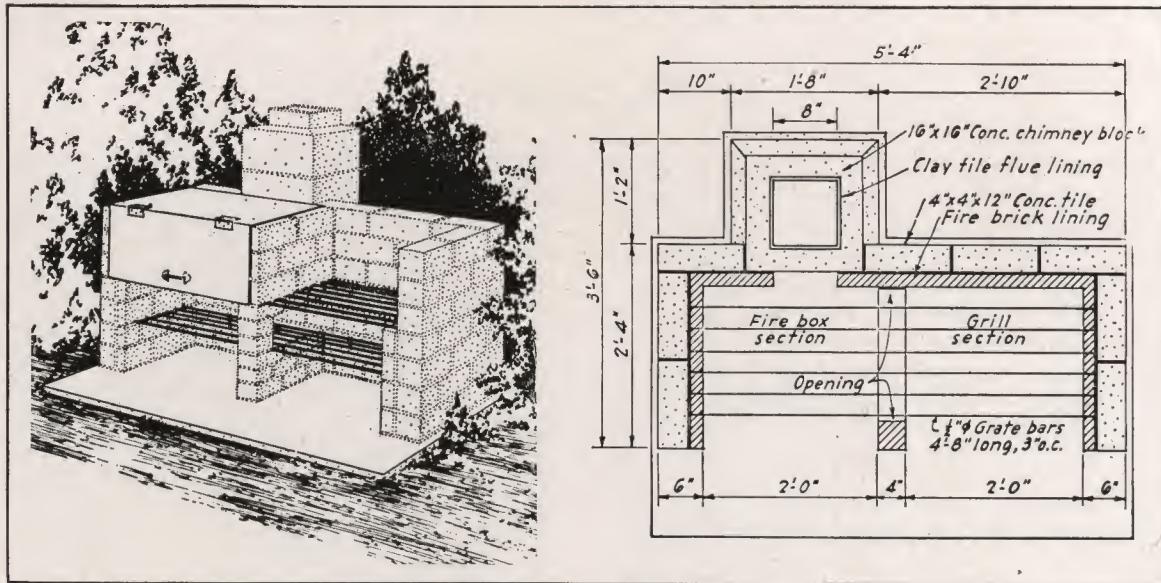
OUTDOOR fireplaces and barbecue pits provide pleasant, friendly settings for many happy hours spent out of doors. A yard need not be large to set off effectively any style of fireplace, and it is surprising how economically they can be built.

There are two general types of outdoor fireplaces, either of which may be built of concrete masonry or reinforced concrete*. The horizontal or rustic fireplace is simply an open grill for cooking over the fire on a low, oven-like enclosure. The perpendicular or wall fireplace is suggested by interior fireplaces. Either type can be given any of an almost unlimited number of finishes. They may be built as separate units or as part of the garden wall—depending upon landscape effects desired. When landscape layout permits, a secluded spot should be selected for the open hearth. Shrubs and hedges may provide a fitting screen about it to give privacy to open air parties.

*For additional suggested designs of various types of outdoor fireplaces, write for Concrete Information sheet, *An Outdoor Fireplace for Your Yard*.



A reinforced concrete fireplace.



Details of construction for a concrete masonry barbecue pit or stove.

If there are tall trees and heavy shrubbery in the garden area a fireplace with a tall chimney would be quite appropriate. Whenever possible the fireplace should be so placed that the opening will face the prevailing wind to assure good draft and keep the smoke out of the eyes.

Concrete Masonry Fireplaces

Many people have found it both desirable and economical to build fireplaces of concrete masonry units. The units may be 4, 6 or 8 in. thick, depending on the type of fireplace to be erected. Mortar for laying up these units should be carefully mixed, using 1 sack portland cement and 3 cu.ft. mortar sand, to which a plasticizing agent may be added. Mix these materials together dry in a mortar box. Then add water and again mix thoroughly to obtain desired plasticity. Concrete mixture for base of the fireplace is given in the table on page 35.

One 3x4-in. steel angle of proper length is required over the fireplace opening.

Cast-In-Place Concrete Fireplaces

Fireplaces similar to those built of concrete masonry may be erected with concrete placed in forms. The mix used here is the same as that for the base of the masonry fireplaces. Well braced forms of proper dimensions should provide for 6-in. thick walls. The reinforcement should comprise $1/4$ -in. steel bars, 12 in. on center in the

walls both horizontally and vertically. In place of bars, a welded wire fabric having an equivalent cross-sectional steel area will provide sufficient reinforcement.

Fire-Brick Lining

Most fireplace designs include a fire-brick lining. In small barbecue pits, however, a fire-brick lining is not absolutely necessary. Two properties of good concrete—durability and fire resistance—eliminate any need for fire-brick lining in small fireplaces.

Precautions

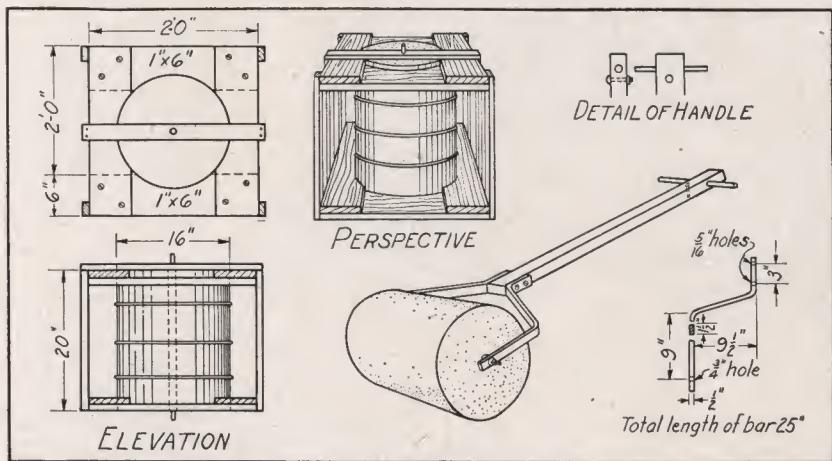
1. In southern climates where little frost enters the ground, deep foundations are not necessary. Farther north, however, where several feet of frost is not unusual, it is best to have a good, solid foundation reaching below the frost line.

2. Do not be too impatient to try out the new fireplace. A fire built too soon after the oven is completed will dry out the concrete and mortar, possibly causing cracks. Cure the concrete properly. Keep it damp for 2 weeks. This may be done by covering the structure with wet burlap or by sprinkling it often so that it remains in a moist condition during this period.

3. Select the oven, steel plates or grills, after the fireplace is completed. These fixtures can then be cut to correct size, avoiding errors and extra expense.

Lawn Roller

PLANS for making a practical, long-lasting concrete lawn roller are shown on this page. The forms are assembled as indicated, fitting the clamps around the galvanized iron sheet which is bent to circular form with its ends overlapping. If necessary the metal may be tacked to the clamps. An iron pipe is set in the exact center of the form, using wood strips with accurately bored holes to fit the pipe



Construction details for a concrete lawn roller.



This lawn roller was built from plans given above.

at top and bottom. Oil all surfaces with which the concrete will come in contact to make removal of forms easy.

The proper mixture for this type of work is shown in the table on page 35. Place the concrete in the forms spading it well and smooth off the top with a trowel. Metal form may be taken off after about 48 hours and any holes in the surface filled with 1:2 portland cement-sand mortar. Allow roller to cure for at least 10 days, wetting thoroughly every day. After it has cured thoroughly, the roller may be assembled as in drawing. A handle such as shown in the drawing can be obtained from the local hardware dealer, or made with pipe and fittings as shown.

Refuse Burner and Ash Receptacles

DESIGN for making an inexpensive concrete masonry refuse burner is shown on next page.

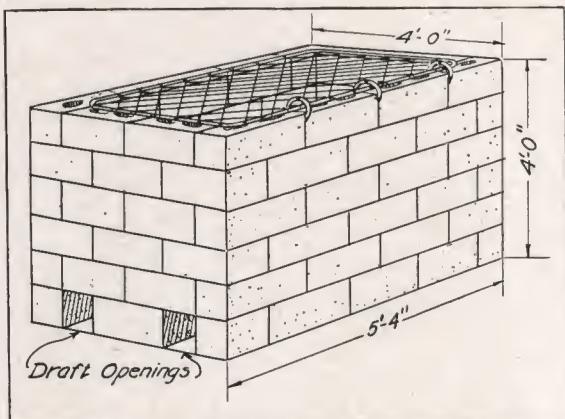
An excavation is made 6 in. deep upon which the base is laid. The base form is then assembled and set in place. The recommended proportions for this work are shown in the table on page 35. Place the concrete in the form, tamping it thoroughly. Level off the surface by means of a strike-

Concrete garbage and ash receptacles are sanitary conveniences.



board resting on the edges of the form. Allow the base to harden 24 hours before removing the forms.

Concrete block used for the walls may be secured from a local dealer. A 1:1:6 mortar (1 part portland cement, 1 part lime and 6 parts sand, all measured by volume) is recommended for laying up the units. The bottom course of masonry is laid with half units at the corners, leaving draft holes at each end as indicated. The succeeding courses of units are placed spreading a bed of mortar $\frac{1}{2}$ in. thick on each preceding course. Each unit as laid is "buttered" on the ends to make well filled vertical joints. Allow the mortar to harden for 2 weeks before using the burner.



Design for a simple concrete masonry refuse burner.

Rotproof Concrete Posts

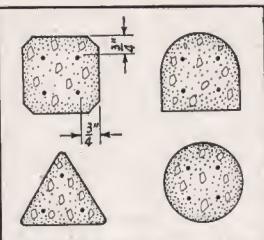
CONCRETE fence posts, grape arbor posts, mail-box standards, clothesline posts and ornamental gate posts do not rot or burn and are not injured by borers or fungus growths. All concrete posts are made in practically the same manner, the main difference being in their size and shape. Cross-sectional views of several practical post designs are shown to the left*.

Concrete posts may be purchased from your local concrete products plant, which usually carries a stock of good

quality posts; or the posts may be manufactured at home using ready-made steel molds or homemade wood molds. Triangular, round, half-round and T-shaped posts are usually made in metal molds, of which there are a number on the market.

A simple design for a 5-post homemade wood mold is shown on the next page. This may be varied in size and shape to make fence posts, clothesline supports, etc. Seven feet is a good length for fence posts, allowing them to be set 2 or $2\frac{1}{2}$ ft. in the ground. The lumber used in constructing the forms should be sound, straight-grained and smooth on all sides that will come in contact with the concrete. Two-inch material

*For full details on materials and construction of standard concrete fence posts, vineyard posts, etc., write for information sheet, *How to Make Concrete Posts*.



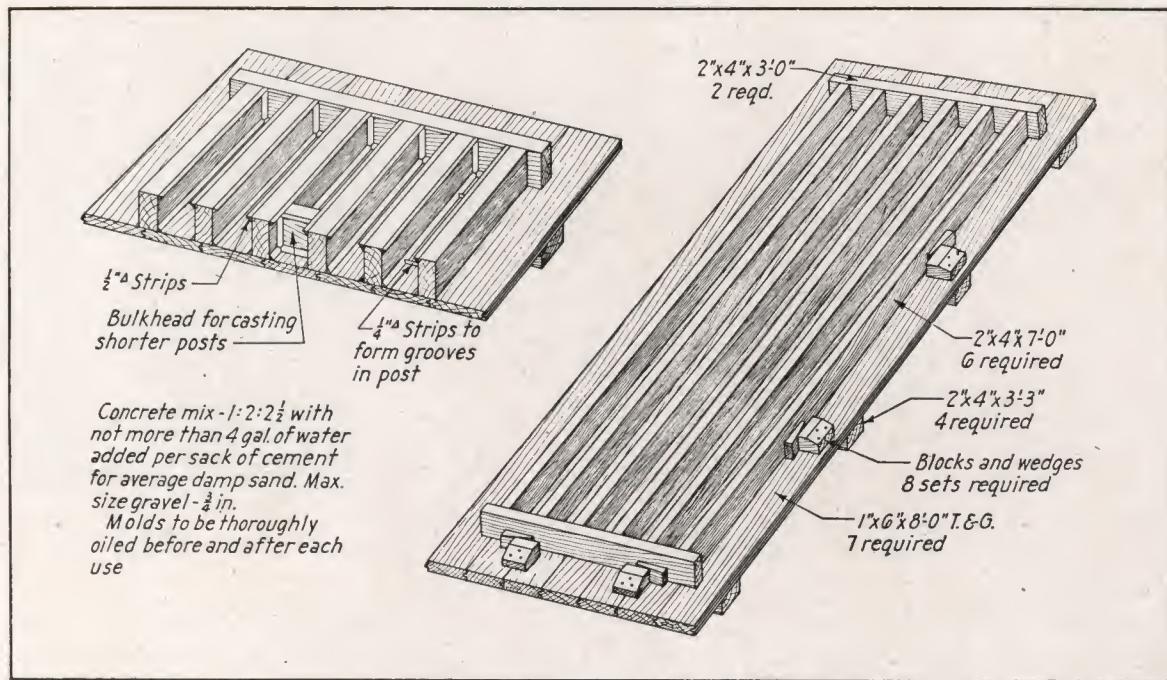
Common shapes of concrete posts.

Concrete posts stay put, won't rot or rust. They are easy and economical to make.



Concrete posts provide durable, rotproof supports for heavily laden grape vines.





Details of mold for five concrete fence posts.

is used for the sides and end pieces and for the divider. Triangular strips are tacked to the sides and divider to give the posts beveled edges. Forms should be oiled to prevent the boards from warping and the concrete from sticking.

One-quarter-inch round or square rods make good reinforcement for concrete posts and should be placed as shown by the black dots in the cross section on page 26. The rods are located near each corner and $\frac{3}{4}$ in. from the surface.

The table on page 35 shows the proper mixture for concrete posts. The thoroughly mixed concrete is placed about 1 in. deep in the form, then two reinforcing rods are placed one in each corner $\frac{3}{4}$ in. from the side and bottom. Fill the form then to within $\frac{3}{4}$ in. of the top and place the other two reinforcing rods. Fill the form to the top, smooth off and trowel. As concrete is placed, it should be compacted by tapping the form and by running the trowel along the sides and up and down in the concrete, thus removing air bubbles and producing posts with smooth surfaces. Care must be taken not to move the reinforcement.

The forms should remain undisturbed until the concrete has hardened sufficiently to permit removing posts without damaging them. Twenty-four hours is usually sufficient in summer, but

in cold weather more time is required.

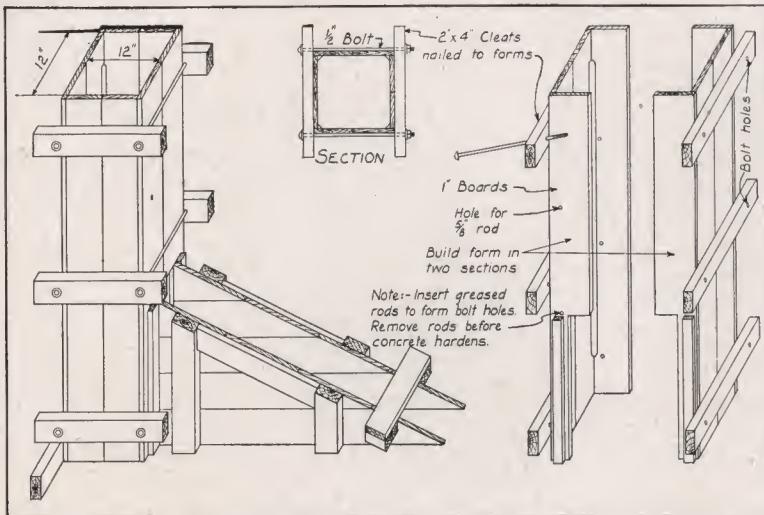
In summer, the posts should be placed in a shady place and wetted at least twice daily for about 10 days. If shade is not available, a covering of sand or straw kept moist by sprinkling is satisfactory. Do not set posts until they have cured at least 28 days.

Corner, Gate and Entrance Posts

Concrete posts at the end of fence lines are subjected to heavy pulls and therefore they must be made larger and reinforced more heavily than ordinary fence posts. Gate posts sustain the load

These massive concrete entrance posts provide permanent support for the gate and enhance the beauty of the grounds.





Forms for corner, end or gate posts cast in place.



This concrete mailbox standard will last indefinitely.

of the gate and must likewise be large, while entrance posts are usually made massive to make them impressive in appearance.

On account of their size and weight large posts are usually built in place. Excavate carefully to a depth of not less than 3 ft. so that the earth may serve as forms for the part of the post below grade. Fill the excavation with concrete, using the mixture recommended in the table on page 35. Care should be taken to place reinforcing

rods so they will extend from the top of the posts to a point at least 2 ft. below the ground.

Forms for casting the above-grade portions of the posts are next placed, and the concreting completed. If braces are cast with the posts, the rods reinforcing them should extend well into the main post. When building corner or gate posts, bolts and fittings necessary to attach wires or to receive the gate should be well embedded in the concrete.

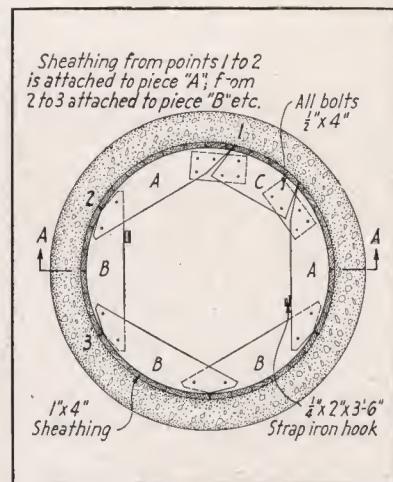
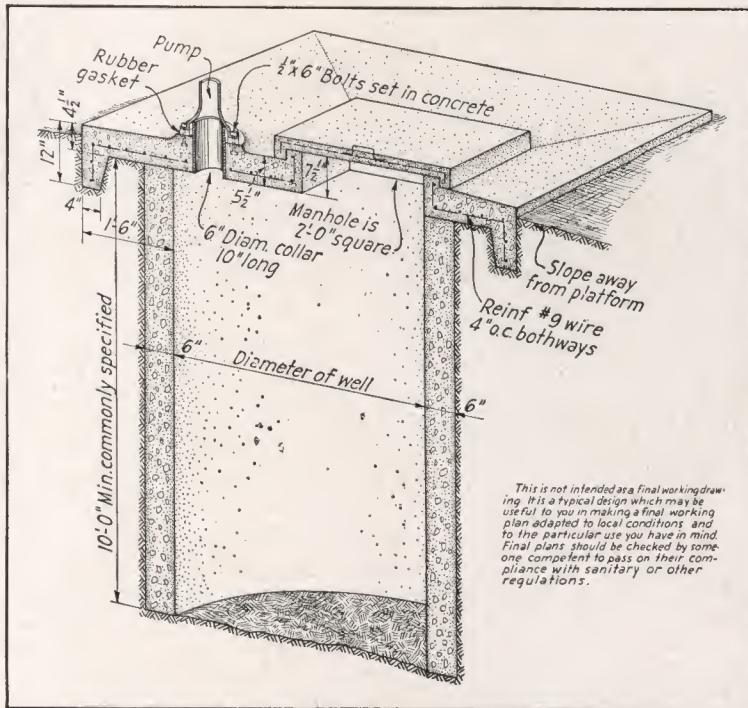
Well Curbs and Platforms Protect the Water Supply

A CONCRETE well curb and platform are recommended by health authorities as a permanent means of insuring spring and well water supplies against contamination. The concrete curb extends high enough to prevent surface water from entering and deep enough to exclude seepage and burrowing animals. The concrete platform or covering completes the protection.

The earth wall of the well is generally sufficient for the outer forms, but if not, the excavation will have to be enlarged to provide room for setting wood forms. A convenient collapsible interior form, made of 1-in. material, is shown in the accompanying drawing. It is made in four sections, the crosspieces being held together by



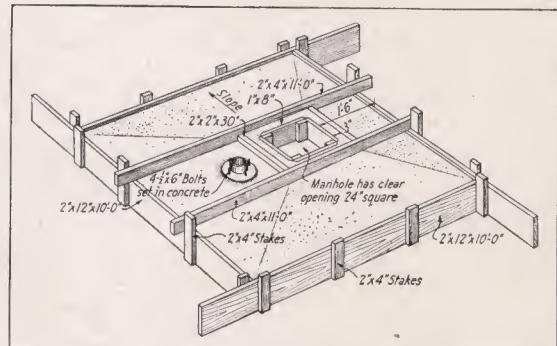
A concrete well curb and platform protect the water supply.



Reusable forms for circular wells.

Left—Cross section of concrete well platform and curb for dug wells.

Below—Forms for precasting well platform.



bolts which are removed when the form is taken down. The sheathing boards should not be more than 4 in. wide. Apply oil to form faces next to concrete to make removal easy. For the small well a curb 4 in. thick is sufficient, but for wells 3 ft. or more across, 6 in. is recommended.

For wells and spring enclosures 6 ft. or less in diameter a platform 4 in. thick at the edges is adequate. Quarter or $\frac{3}{8}$ -in. reinforcing rods should be placed 6 in. apart in both directions and located about 1 in. above the lower surface of the concrete. The platform should extend well over the edges of the well curb. It should be at least 1 in. higher at the center to insure drainage.

A tight board platform braced in position from below or suspended by wires or brackets to the previously placed curb will serve as a bottom form for the cover. Before placing concrete, provide for an 18-in. manhole, also an opening for the pump stock. Bolts may be set in the concrete for attachment to pump base. A cross-sectional view showing construction of the cover slab and the manhole is shown*. The removable cover for the manhole is made separately. Another method of providing a manhole is to set a large dishpan on the platform form, the concrete being placed around it and sloped upwards slightly against the pan. Removal of the pan will provide an

opening with sloping edges in the concrete. A tight fitting cover can be made by casting it in the pan. The drawing of the cistern on page 30 shows this method. It is not considered as sanitary a cover as the first mentioned.

The concrete mixture recommended is given in the table, page 35. As the concrete is placed it should be tamped and spaded. Any rough spots found on removal of the forms are patched with a 1:2 concrete mortar. Finish the platform with a wood float to a smooth, yet gritty surface.

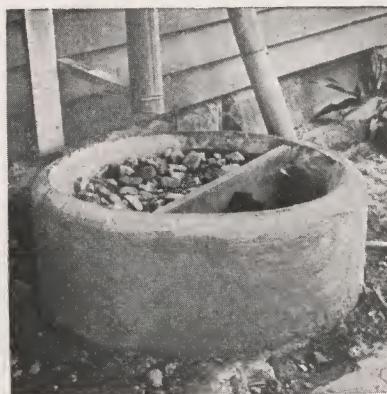
*Additional details on forms for wells and construction for spring protection are given in Concrete Information sheet, *How to Protect the Water Supply*. Write for your free copy.

Cisterns

A SANITARY concrete cistern in which to store soft water for laundry and other household uses is a welcome home improvement. Cisterns are often used to store drinking water. Concrete construction keeps out burrowing rodents, polluted surface water and seepage. Since rain water gathers impurities in passing through the air and over roofs a screen or filter through which the water must pass in entering the cistern is important.

Cisterns may be built either round or square and of any size required to meet the needs of the family. The accompanying plan shows a circular cistern having a capacity of 3,420 gal.

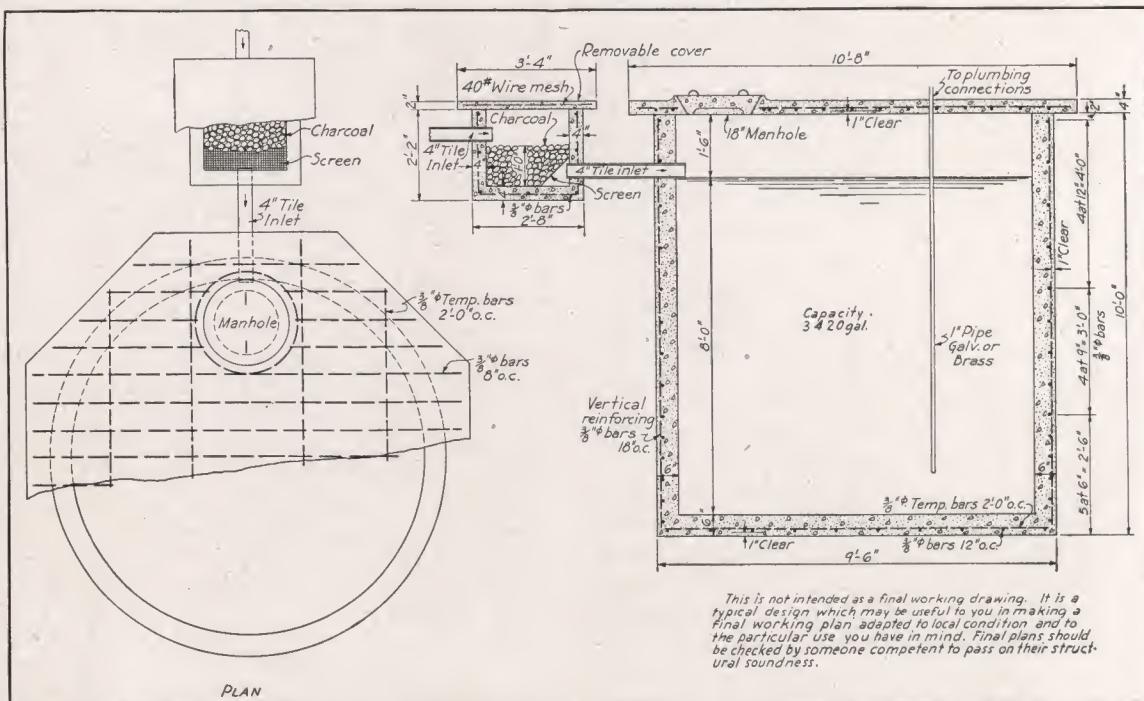
If the soil is firm, the earthen walls of the pit will serve as the outside forms. A convenient interior form may be assembled as shown on page 29 for well curbs. Sheathing boards may be



A filter for cistern water.

of 2-in. material not more than 4 in. wide. A hole should be cut in the form about 18 in. below the surface to allow for the inlet tile. The hole is placed at the joint of two sections of the form (a half-hole in each section) to make removal of the forms easy. The tile should be firmly placed in position before concreting begins. The floor and walls should be placed in one operation, the interior form being supported across the top of the excavation

so that it hangs 6 in. (thickness of floor) above the floor of the pit. This eliminates any joints between the floor and wall which if present might permit leakage. Oil the forms to facilitate their removal. Place reinforcement as shown in the drawing and before concrete is placed. Take care not to displace it when spading and tamping concrete in the forms.



Construction details for building a circular concrete cistern. The filter shown can be built if desired.

When the concrete has hardened sufficiently to be self-supporting the forms may be removed and any rough spots patched with a 1:2 portland cement-sand mortar.

The reinforced cover slab should be 4 in. thick and overlap the walls about 8 in. A tight board platform should be constructed for the bottom form and can be braced in position by 2x4's resting on the floor of the cistern. Provide for a manhole in the cover slab, using either type described under well platforms on page 29 and insert proper pipes for attachment of pump or plumbing connections. The bracing can be removed through the manhole when the cover has hardened. Two-inch material will serve for side forms of the cover slab.

Quarter or $\frac{3}{8}$ -in. reinforcing rods spaced 6 in. apart should be placed in both directions about 1 in. from the bottom surface of the cover slab. Finish to a smooth, yet gritty surface.

The recommended concrete mixture for this work is given in the table on page 35. Follow carefully the recommended practice in mixing, placing and curing concrete. Do not use the cistern for 2 weeks after concrete has been placed.

A simple filter can be made as shown in the drawing. The walls are made 4 in. thick. Use the same concrete mixture as for the cistern. The cover should be removable to allow access for cleaning and should be tight fitting and overlap the walls slightly. Charcoal makes an excellent filtering material.

Sanitary Concrete Septic Tanks

A CONCRETE septic tank is good health insurance. It provides a safe method of disposing of wastes from the modern bathroom and the kitchen sink.

A septic tank is a watertight concrete receptacle in which the solid particles of sewage are broken up by bacterial action. Part of the solids is converted into gases while a portion called sludge sinks to the bottom. Baffle boards and special inlets and outlets are provided so that incoming sewage will cause the least possible disturbance of the sewage in the tank.

A septic tank should be made large enough to hold a minimum of 50 gal. for every person served. It is seldom advisable to build a tank holding less than 450 gal. though serving only two or three people.

The liquid flowing out of the septic tank is far from being pure and is given further treatment in what is known as the purification field. This consists of one or more lines of ordinary drain tile laid with open joints into which the sewage is discharged and allowed to seep into the surface soil where bacteria of another sort complete the process of purification.



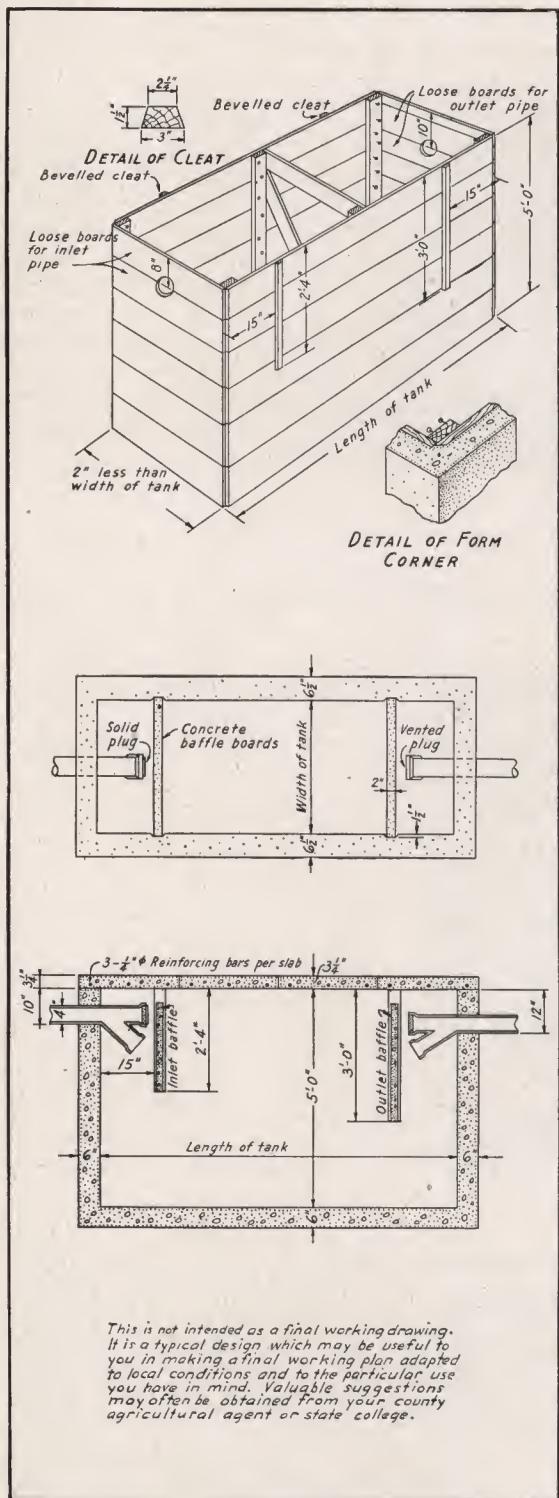
Septic tank, cover removed.

These tile are laid from 12 to 18 in. below the surface of the ground and at a pitch of $\frac{1}{2}$ in. in 10 ft. to insure good drainage. Where the soil is light and porous and the ground water level is several feet below the surface, 30 ft. of tile per person is sufficient. In tight, clay soils 100 ft. of tile per person is often required.

The sewer lines connecting plumbing systems of the house and septic tank should consist of bell-mouthed sewer tile with tightly cemented joints. Tile carrying sewage should never be laid with open joints in the vicin-



Method of building cover slabs with handles in top.



Details for a sanitary concrete septic tank.

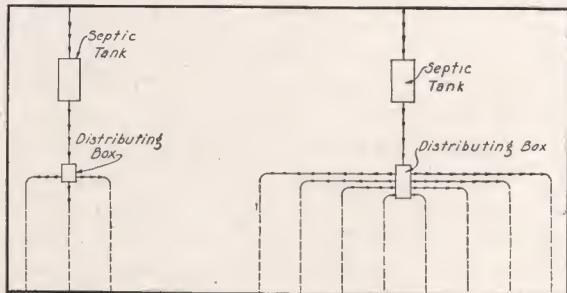
ity of a well or other source of water supply.

A septic tank is usually built in place. An excavation is first made and if the soil is firm and will not cave the earthen walls of the pit may be used for outside forms. In this case the excavation should be made to the exact dimensions of the outside measurements of the tank. Be sure that the sides of the pit are smooth and vertical and the corners square. If the soil caves, both outer and inner forms will be required. Construct the inside forms as shown in the drawing. The beveled cleats on the form are to make grooves for the insertion of baffle boards. Inlet and outlet fittings must be secured in place when concrete is placed.

A septic tank must be watertight. Use the recommended mixture for this type of work shown in the table on page 35. The floor and walls should be placed in one operation so as to eliminate joints. This may be done by supporting the interior form so that it hangs 4 in. from the floor of the pit. As soon as the 4-in. floor is placed the concrete for the walls may be deposited. Oil the forms well to facilitate removal. The concrete should be deposited for the side walls in 6 or 8-in. layers, spading and tamping it while placing.

The cover slab is made using the same mixture as for the tank and is reinforced with $\frac{1}{4}$ or $\frac{3}{8}$ -in. rods. It is usually constructed in several sections. In figuring dimensions and assembling forms be certain to allow for lap-joints between sections.

In warm weather, forms may usually be removed the day following concreting. The concrete should be allowed to harden for 3 weeks in warm weather and longer in cold before tank is put into use.



Layout of septic tank and purification field.

Hotbeds and Cold Frames

AN easy way to extend the season of the home garden is to build a concrete hotbed or cold frame. Advancing early spring plants is another use. Cold frames and hotbeds are much the same except that the walls of the latter are usually carried deeper into the ground to form an inclosure for a filling of manure.

The location of beds should be such that full exposure to the sun is obtained. Protection from cold winds is desirable. A location on the south side of a building is ideal provided water from the eaves does not drip on the beds. Plans for a simple hotbed are given below.

Pits for hotbeds are usually dug from 10 in. to 3 ft. deep. The length is made some multiple of 3 ft. as this is the width of standard hotbed sash. The width of the bed is also made to accommodate standard sash. On small beds old window or storm sash may be utilized provided the bed is made of dimensions to suit.

For a 4-sash frame the excavation should be laid out 6 ft. 6 in. in width by 12 ft. 9 in. in length. The latter dimension allows for necessary sash supports or bars which run across the bed. These are made of 1-in. dressed lumber and resemble an inverted "T" when in place. Walls



Hotbeds and cold frames built of concrete are rotproof.

of the bed are made 6 in. thick.

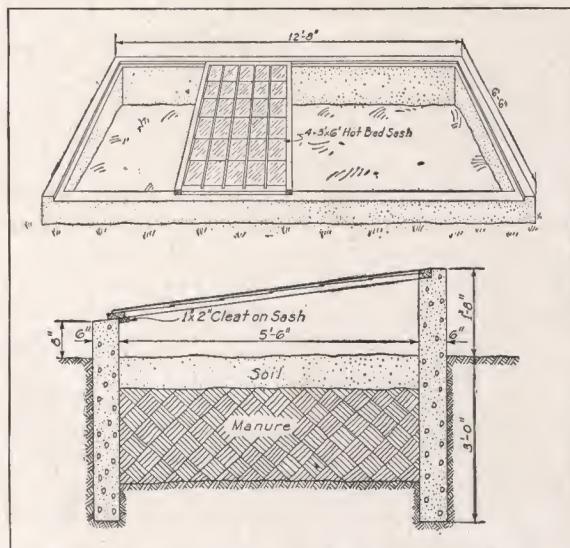
The bed is usually constructed so that the top of the south wall is about 6 in. and the north wall 12 to 18 in. above grade. This gives a slope from 6 to 12 in. As it is difficult to dig a 6-in. trench for concrete walls it is customary to make the excavation for the bed first, utilizing the earth for the outer forms up to ground level and using 1-in. boards above grade and for the inner forms. Recesses may be cast in the top surfaces of the wall to receive sash.

The recommended mixture for this work will be found in the table on page 35. Read carefully the instructions for proportioning, mixing, placing and curing.

When the concrete has hardened, hotbeds are banked with earth and the embankment is sometimes covered with straw or manure to prevent loss of heat.

Cold frames differ from hotbeds in that no manure is used to supply the heat. Soil for cold frames should be of sandy nature as it responds more quickly to fertilizer, is usually better drained than heavy soil, and plants are not so apt to be injured by excessive watering.

Drainage, both surface and underground, is essential and the ground should therefore slope away from the site of the bed. Without ample drainage, water may collect in the pit and delay the growth of the plants and seriously check the fermenting of the manure. A tile drain about 4 in. in diameter is often placed so that the bed will be drained should any water chance to collect.



Perspective and cross-sectional views of a 4-frame concrete hotbed.

Tree Surgery

MANY a fine old tree whose heart is being eaten out by decay can be given a new lease on life by the intelligent use of a little concrete. Tree cavities gradually increase in size until through lack of nourishment the tree starves, weakens and eventually dies.

The cavity should first be thoroughly cleaned, the dead and decayed parts cut out regardless of the size of the wound which is made. Because fungus growths left in the tree under the concrete may cause decay to continue, the interior surface should be treated with creosote, crude petroleum or some other solution which prevents growth of fungus.

Care must be taken not to bring the creosote in contact with the cambium or growing layer which is under the inner bark, as creosote will kill the growing cells with which it comes in contact. Therefore, keep the creosote about an inch away from the cambium. A good plan is to paint the sap wood, cambium and edges of the bark along the cavity with shellac to keep them from drying.

Following this a thick coating of hot tar should be applied over the creosote to act as an expansion joint. Then slight movement of the tree will be less likely to cause the concrete to crack. If the cavity is 6 in. or more across the concrete should be reinforced. This may be accomplished by using pieces of heavy wire or $\frac{1}{4}$ -in. rods extending from side to side of the opening.

One important point in filling the cavity should be noted: the concrete filling should be brought out just to, or better stated, just below the growing layer, so that the new cells can readily grow over it.

For shallow cavities use a stiff mortar of 3

parts sand and 1 part portland cement with just enough water added so that the mix forms a lump when squeezed in the hand.

Shallow cavities should be filled in 6-in. sections as follows: Hold a board up against the lower 6 in. of the cavity with one hand, and with the other fill the cavity with mortar as high as the top of board. Tamp the mortar down thoroughly filling every crevice. When the 6-in. section is completely filled with mortar, smooth and level top of section. Then cut a tar paper divider and place it on top of the section*. Now slide form board up, fill and tamp a second section. Then scrape off loose mortar from lower section and give it a smooth surface with a trowel. The face of the concrete patch should be rounded slightly to conform to shape of the tree. Repeat process to fill cavity.

A deep cavity can be back-filled to within 4 to 6 in. of the front or opening, with a stiff mix of either 1 sack portland cement to 5 cu.ft. bank-run gravel or 1 sack cement to 4 cu.ft. sand and 4 cu.ft. gravel. Backfill can be either a solid fill or sections. Tack a piece of tar paper down the face of the backfill, then fill the face of the cavity with the portland cement-sand mortar in sections as explained.

Completed sections of the concrete filling should be kept moist for about 10 days for proper curing of the concrete. The bark and sap wood will eventually grow over the edges of the concrete filling. If proper care has been taken in preparing the cavity, placing and curing the concrete, decay will be checked and the life of tree preserved.

*Divider should be cut shallower than opening so that front edge does not show on face of completed section.



Fine old trees can be given a new lease on life by the intelligent use of concrete.

How to Make Good Concrete

UNTIL the recent discovery that the strength, durability and watertightness of concrete depend upon the proportion of water to portland cement it was customary to specify mixtures as 1 part cement to a certain number of parts of sand and pebbles. Modern practice is to state the amount of mixing water for each sack of portland cement, varying the amount according to the class of work. For example, the recommended mixture for sidewalks is 5 gal. of water per sack of portland cement, when sand and pebbles are in a wet condition. Moisture in the aggregates is free to act on the cement, so less water is added in this case than if these were absolutely dry. Had they been dry, the correct amount of water would be 6 gal. for each 1-sack batch.

Portland Cement Binds Particles Together

In a concrete mix, portland cement and water

form a paste which, upon hardening, acts as a binder cementing the particles of sand and pebbles together. The use of too much mixing water thins or dilutes the paste, weakening its cementing qualities. Therefore, it is important that portland cement and water be used in proper proportions to get the best results.

The accompanying table gives recommended quantities of water for different classes of work and also suggests proportions of portland cement to sand and pebbles to use in trial batches. The trial batch for sidewalks is 1 part portland cement to $2\frac{1}{4}$ parts sand and 3 parts pebbles (1:2 $\frac{1}{4}$:3 mix). It may be necessary to change the amounts of sand and pebbles as will be described to obtain a smooth, plastic, workable mix. Do not vary the amount of water from the quantity shown.

The trial proportion (1:2 $\frac{1}{4}$:3) suggested for

RECOMMENDED MIXTURES FOR SEVERAL CLASSES OF CONSTRUCTION

Intended primarily for use on small jobs

Kind of Work	U. S. gallons of water to add to each 1-sack batch			Trial mixture for first batch			Maximum aggregate size
	Damp sand and pebbles	Wet sand and pebbles	Very wet sand and pebbles	Cement	Sand	Pebbles	
Foundation walls which need not be watertight, mass concrete for footings, retaining walls, garden walls, etc.	6 $\frac{1}{4}$	Average sand 5 $\frac{1}{2}$	4 $\frac{3}{4}$	sacks 1	cu.ft. 2 $\frac{3}{4}$	cu.ft. 4	in. 1 $\frac{1}{2}$
Watertight basement walls, walls above ground, lawn rollers, hotbeds, cold frames, etc.	5 $\frac{1}{2}$	Average sand					
Well curbs and platforms, cisterns, septic tanks, watertight floors, sidewalks, stepping-stone and flagstone walks, driveways, play courts, outdoor fireplace base and walls, refuse burners, ash receptacles, porch floors, basement floors, garden and lawn pools, steps, corner posts, gate posts, piers, columns, etc.		5	4 $\frac{1}{4}$	1	2 $\frac{1}{4}$	3	1 $\frac{1}{2}$
Fence posts, grape arbor posts, mailbox posts, etc., flower boxes and pots, benches, bird baths, sun dials, pedestals and other garden furniture, work of very thin sections.	4 $\frac{1}{2}$	Average sand 4	3 $\frac{3}{4}$	1	1 $\frac{3}{4}$	2	$\frac{3}{4}$



A concrete mixture which contains correct amount of portland cement-sand mortar. With light troweling all spaces between pebbles are filled with mortar. Note appearance on edges of pile. This is a good workable mixture and will give maximum yield of concrete with a given amount of cement.

sidewalks may result in a mixture that is too stiff, too wet or which lacks smoothness and workability. This is remedied by changing slightly the proportions of sand and pebbles, *not the water*. If the mix is too wet, add sand and pebbles in small amounts until the right degree of plasticity is obtained. If the mix is too stiff cut down the amounts of sand and pebbles in the next batch. In this way the best proportions for any job may be determined.

How to Obtain Workable Mixture

A workable mixture is one of such wetness and plasticity that it can be placed in the forms readily, and that with spading and tamping will result in a dense concrete. There should be enough portland cement-sand mortar to give good smooth surfaces free from rough spots, and to bind pieces of coarse aggregate into the mass so they will not separate out in handling. In other words the cement-sand mortar should completely fill the spaces between the pebbles and insure a smooth plastic mix. Mixtures lacking sufficient mortar will be hard to work and difficult to finish. Too much sand increases porosity and cuts down the amount of concrete obtainable from a sack of cement.

A workable mix for one type of work may be too stiff for another. Concrete that is to be deposited in thin sections like fence posts must be more plastic than for more massive construction such as walls. A good rule to follow is to pro-

portion the sand and pebbles to obtain the greatest volume of concrete of correct plasticity for the work to be done.

Aggregates

Sand and pebbles or crushed rock are usually spoken of as "aggregate". Sand is called "fine aggregate" and pebbles or crushed stone "coarse aggregate". Fine aggregates such as rock screenings include all particles from very fine (exclusive of dust) up to those which will pass through a screen having meshes $\frac{1}{4}$ in. square. Coarse aggregate includes all pebbles or broken stone ranging from $\frac{1}{4}$ in. up to $1\frac{1}{2}$ or 2 in. In thin walls or slabs the largest pieces of aggregate should never exceed one-third the thickness of the thinnest section. Maximum sizes of aggregate for different classes of work are shown in the table.

Sand should be clean and hard, free from fine dust, loam and clay and vegetable matter. These foreign materials prevent bond between the cement and sand thereby reducing the strength of the concrete. Concrete made with dirty sand hardens very slowly and often will not harden sufficiently to be used for its intended purpose.

Sand should be well graded, the particles should be not all fine nor all coarse, but should vary in size from fine up to that which will just pass through a $\frac{1}{4}$ -in. mesh screen. If the sand is well graded the finer particles help to fill the spaces between the larger ones.

Pebbles or crushed stone should be tough, fairly hard and free from foreign matter. Stone containing considerable soft, flat or elongated particles should not be used.

Bank-Run Gravel

Bank-run gravel is the natural mixture of sand and pebbles taken from a gravel bank. In this material fine and coarse aggregates are seldom present in proper proportions, usually there is too much sand. Money can be saved by screening out the sand and recombining in proper proportions according to the class of work.

Water

Water used in mixing concrete should be clean, free from oil, alkali, and acid. In general water that is fit to drink is good for concrete.

Measuring Materials

All materials including water should be accurately measured. A pail marked on the inside at different heights to indicate quarts and gallons

will be found handy for measuring water. A pail may also be used for measuring cement, sand and pebbles. In mixing 1-sack batches it is not necessary to measure cement as 1 sack holds exactly 1 cu.ft. Sand and pebbles are then most conveniently measured in bottomless boxes made to hold 1 cu.ft., 2 cu.ft., or other volumes desired.

Mixing the Concrete

Although machine mixing is preferred, first class concrete can be mixed by hand. Whichever way is used, mixing should continue until every pebble is completely coated with a thoroughly mixed mortar of portland cement and sand.

If a tight floor is not available for mixing concrete a watertight mixing platform should be made. It should be large enough for two men using shovels to work upon at one time. A good size is 7 ft. wide and 12 ft. long. This platform is preferably made of matched lumber so that the joints will be tight. Strips are nailed along three sides to prevent materials from being pushed off in mixing.

The measured quantity of sand is spread out evenly on the platform and on this the required amount of portland cement is evenly distributed. The cement and sand are turned with square-pointed shovels to produce a mass of uniform color, free from streaks of brown and grey. Such streaks indicate that cement and sand are not thoroughly mixed. The required amount of coarse aggregate is then measured and spread in a layer on top of the portland cement-sand mixture. Mixing is continued until the pebbles have been uniformly distributed throughout the mass. A depression or hollow is then formed in the middle of the pile and the correct amount of water added while the materials are turned. This mixing is continued until the portland cement, sand and pebbles have been thoroughly and uniformly combined.

The concrete should be placed in the forms within 30 minutes after mixing. It should be well tamped or spaded as it goes into the forms. This operation forces the coarse aggregate back from the face making a dense concrete with smooth surfaces.

Curing

Do not permit the newly placed concrete to dry out. Protect it from the sun or drying winds for a week or 10 days, otherwise the water necessary for proper hardening will evaporate result-

STEPS IN CONCRETE MIXING



Steps in the work of mixing concrete by hand. Thorough mixing and accurate control of water are essential for satisfactory results.

ing in loss of strength. Floors, walks and similar surfaces can be protected by covering with earth or straw kept moist by occasional sprinkling as soon as the concrete has hardened sufficiently so that it will not be injured.

Walls and other sections which cannot be conveniently covered by this method can be protected by hanging moist canvas or burlap over them and wetting down the work frequently for 7 days or so after placing. In cold weather work

should be protected but need not be kept moist.

Reinforcement

Reinforcement is the term used to describe the steel rods or mesh that are placed in the concrete to increase its strength where subjected to forces tending to bend or pull it apart. Care should be taken to place the reinforcement in correct position and in the part of the concrete mass where it will be most effective.

How to Figure Quantities

QUANTITIES OF CEMENT, FINE AGGREGATE AND COARSE AGGREGATE REQUIRED FOR 1 CU.YD. OF COMPACT MORTAR OR CONCRETE

MIXTURES			QUANTITIES OF MATERIALS				
Cement	Fine Aggregate (sand)	Coarse Aggregate (gravel or stone)	Cement in sacks	Fine Aggregate		Coarse Aggregate	
				cu.ft.	cu.yd.	cu.ft.	cu.yd.
1	2	...	12	24	0.9	...	...
1	3	...	9	27	1.0	...	...
1	1	1 3/4	10	10	0.37	17	0.63
1	1 3/4	2	8	14	0.52	16	0.59
1	2 1/4	3	6 1/4	14	0.52	19	0.70
1	2 3/4	4	5	14	0.52	20	0.74

1 sack cement = 1 cu.ft.; 4 sacks = 1 bbl. If concrete aggregates are sold in your locality by weight, you may assume for estimating purposes that a ton contains approximately 22 cu.ft. of sand or crushed stone; or about 20 cu.ft. of gravel. For information on local aggregates consult your building material dealer.

MATERIALS REQUIRED FOR 100 SQ.FT. OF SURFACE FOR VARYING THICKNESSES OF CONCRETE OR MORTAR

Quantities may vary 10 per cent either way, depending upon character of aggregate used. No allowance made for waste.

Thickness of mortar or concrete (in.)	Amount of mortar or concrete (cu.yd.)	PROPORTIONS								
		1:2			1:3			1:1:1 3/4		
		Cement (sacks)	Fine Aggregate (cu.ft.)	Coarse Aggregate (cu.ft.)	Cement (sacks)	Fine Aggregate (cu.ft.)	Coarse Aggregate (cu.ft.)	Cement (sacks)	Fine Aggregate (cu.ft.)	Coarse Aggregate (cu.ft.)
3/8	0.115	1.4	2.8	...	1.0	3.0	...	...	...	...
1/2	0.15	1.8	3.6	...	1.3	4.0	...	...	...	...
3/4	0.23	2.7	5.4	...	2.0	6.0	...	2.3	2.3	3.9
1	0.31	3.7	7.4	...	2.7	8.1	...	3.1	3.1	5.3
1 1/4	0.38	4.5	9.0	...	3.3	10.0	...	3.8	3.8	6.5
1 1/2	0.46	5.4	10.8	...	4.0	12.0	...	4.6	4.6	7.8
1 3/4	0.54	6.4	12.8	...	4.7	14.1	...	5.4	5.4	9.2
2	0.62	7.3	14.6	...	5.4	16.2	...	6.2	6.2	10.5
1:1 3/4:2										
3	0.92	7.5	12.9	14.7	5.8	12.9	17.5	4.6	12.9	18.4
4	1.24	10.0	17.3	19.9	7.8	17.3	23.6	6.2	17.3	24.8
5	1.56	...	...	...	9.8	21.7	29.6	7.8	21.8	31.2
6	1.85	...	...	...	11.5	26.0	35.2	9.3	26.0	37.0
8	2.46	15.4	34.4	46.8	12.3	34.4	49.3
10	3.08	19.3	43.2	58.5	15.4	43.2	61.6
12	3.70	23.1	51.8	70.4	18.5	51.8	74.0

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